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1. General info

PHOTOMOD Montage Desktop is a main shell of the digital photogrammetric system PHOTOMOD. PHOTOMOD Montage Desktop is used to create and manage projects and start different PHOTOMOD modules in order to guide the user through all project processing steps from adding images to final creating of digital terrain models, orthomosaics and digital maps.

2. Installation and starting of PHOTOMOD Montage Desktop

PHOTOMOD Montage Desktop is installed along with the PHOTOMOD system by starting setup.exe file from the installation CD. See also readme.txt file on your CD for the installation instructions.

Note. Prior to start PHOTOMOD make sure that PHOTOMOD System Monitor utility (shown by the icon in Windows system tray) is launched. Otherwise, start it using standard OS Windows command START | Programs | PHOTOMOD | Utility | PHOTOMOD System Monitor

You can launch main system module PHOTOMOD Montage Desktop using the following ways:

♦ from standard OS Windows menu: START | Programs | PHOTOMOD | PHOTOMOD Montage Desktop
♦ using pop-up menu by right mouse clicking on the icon (PhMonitor) OS Windows system tray
♦ by clicking the icon that appears on the Desktop after the installation procedure.

At PHOTOMOD Montage Desktop start you will get dialogue window which allows to select the way of module opening:

![PHOTOMOD Montage Desktop module opening options](image)

Fig.1 PHOTOMOD Montage Desktop module opening options

Open recent – opens a project, which has been opened in previous program session
Open/manage – opens Project management window (see the chapter 7.1 Project management)
Create – opens a window for new project creation (see the chapter 5 New project)
Import – opens a window with list of PHOTOMOD projects, created in earlier formats to import them to the current version (see the chapter 7.3 Importing project)
W/o project – the command opens PHOTOMOD Montage Desktop module without any project, that allows to load and view different resources (vector objects, DEM’s, TIN’s etc.) in 2D window, as well as open some PHOTOMOD modules (DTM, StereoDraw, StereoVectOr and VectOr) without project (see the chapter 4.5 Start PHOTOMOD Montage Desktop without project).
Exit – to exit from PHOTOMOD system.

3. PHOTOMOD modules, basic workflow

Digital photogrammetric system PHOTOMOD 4.3 includes following modules, intended to perform different procedures:
• PHOTOMOD Montage Desktop – creating and managing projects, merging TINs and contour lines
• PHOTOMOD AT – data collection and digital measurement for a block of images
• PHOTOMOD AAT – automatic search and measurement of tie points on block
• PHOTOMOD Solver – block adjustment (phototriangulation)
• PHOTOMOD StereoDraw – 3D vectorization in stereo-mode over a single stereopair
• PHOTOMOD StereoVectOr – parallel work with a map of PHOTOMOD VectOr format in StereoDraw (3D vectorization) and VectOr (map editing) windows
• PHOTOMOD DTM – building and editing TIN and contour lines over a single stereopair
• PHOTOMOD Mosaic – orthomosaicking
• PHOTOMOD VectOr – creating and printing digital maps
• PHOTOMOD ScanCorrect – correcting image geometrical distortion caused by using DTP scanners
Thus the approximate scheme of working in PHOTOMOD system may be as follows:

1. Scan images and correct the scanner distortion by PHOTOMOD ScanCorrect if needed. If you use professional photogrammetric scanner, exclude ScanCorrect module.

2. Create a project in PHOTOMOD Montage Desktop
   - Enter camera parameters in Camera editor or select the existing camera
   - Add the project name, its type and description; select coordinate system
   - Load images and form a pre-oriented block of images based on strips and images overlaps

3. Start PHOTOMOD AT from PHOTOMOD Montage Desktop

4. Perform block processing in PHOTOMOD AT, including
- camera selection
- interior orientation
- control points measurements
- ties between strips
- ties between images
- relative orientation

5. Automatic search, filtration and editing of tie points on images block in PHOTOMOD AAT module, that allows to start automatically the module of block adjustment – PHOTOMOD Solver

6. Exit PHOTOMOD AT and start PHOTOMOD Solver from PHOTOMOD Montage Desktop

7. Perform block adjustment and compute exterior orientation parameters

8. If you are satisfied with adjustment results, switch to Block processing stage, otherwise go back to PHOTOMOD AT to check and correct measurements (PHOTOMOD Montage Desktop)

9. Perform epipolar transformation of images (you can either start transformation for all block images or transform them by pairs once you start PHOTOMOD StereoDraw or PHOTOMOD DTM for selected stereopair)

10. Start PHOTOMOD StereoDraw or PHOTOMOD StereoVectOr for the stereopairs selected one by one

11. 3D vectorization in PHOTOMOD StereoDraw for each stereopair

12. Optional export of 3D vectors to external formats or to PHOTOMOD VectOr map

13. Start PHOTOMOD DTM for each stereopair of the block

14. Build and edit TINs

15. Build and edit contour lines

16. Merge TINs and contour lines created for different stereopairs

17. Optional export of TINs and contour lines to external formats

18. Build Digital Elevation Model (DEM) for the whole block of images in PHOTOMOD Montage Desktop and export it to external formats or to PHOTOMOD VectOr if necessary

19. Start PHOTOMOD Mosaic

20. Build orthomosaic for the entire block of images with a possibility of splitting output orthomosaic into map sheets of selected size and georeference. You can save orthomosaic to external formats or to a map of PHOTOMOD VectOr (RSW file)

21. Export DEM, TINs, vector objects, contour lines to external formats or maps of PHOTOMOD VectOr (module PHOTOMOD Montage Desktop) if necessary

22. Start PHOTOMOD VectOr from PHOTOMOD Montage Desktop

23. Additional mono digitizing over underlying orthomosaic

24. Create a digital map or orthomosaic, split into standard index map sheets, add standard map frame, coordinate ticks and labels, load map symbol libraries and print a map.

4. Stages of project processing

There are 4 main project processing stages in PHOTOMOD system (Block forming, Aerial triangulation, Block adjustment, Block processing). Every stage starts particular PHOTOMOD modules for project processing. Project manager window which opens by menu command Windows | Project manager or by the icon of main panel (see the chapter 8.8 Project manager) is used for switching between the project stages. The current project stage is highlighted by bright green color. To go to another stage you should use the buttons with arrows at the left part of the window. You can also run some PHOTOMOD modules in “read only” mode without transferring to the appropriate processing stage. Besides, you could start some modules without any project, that allows you to view and edit
vector and other types of objects, see the chapter 4.5 Start PHOTOMOD Montage Desktop without project.

![Image](image_url)

**Fig.3 Project processing stages**

### 4.1 Block forming

**Block forming** stage is a first step of working with project. It is used to add block strips and load source images. Images may be rotated or replaced inside the strip if necessary. You can use the main menu or icon panel to work on the Block forming stage but probably **Block editor** window (Windows | Block editor or main panel icon, see the chapter 8.5 Block editor) is more convenient. Icons of Block editor window are duplicated in the Block forming toolbar when the project is on the Block forming stage.

Use the following operations to form the block:

- **add strip.** The system opens Strip properties window to input a strip name (Strip name field) and to set the strip orientation (Forward or Revert). Forward and revert strip orientations are caused by opposite courses of the aircraft on the adjacent strips. These parameters are used while automatic interior orientation process in PHOTOMOD AT (see corresponding User Manual). As a result of strip adding its name appears in the Block editor window.

  **Note. All adjacent images of a strip must have an overlapping area. A strip with a gap must be entered as two separate strips.**

- **delete strip.** The strip should be selected by mouse click in Block editor or 2D window.
- move strip “up” (over the scheme on the screen). The strip should be selected by mouse click in Block editor or 2D window.

- move strip “down” (over the scheme on the screen). The strip should be selected by mouse click in Block editor or 2D window.

- rotate/flip all strip images. Opens a pull-down menu allowing to rotate all strip images at 90, 180 or 270 degrees or flip them vertically or horizontally.

- reverse strip images order.

- strip properties. Click this icon if you want to change strip name, description or orientation (see above). The strip should be selected by mouse click in Block editor or 2D window.

- add images. Select in the Block editor window the strip you need and click this icon to add images. Then you will get the dialogue window, described in the chapter 5.2 Adding image to the project. As a result of images adding, source files are converted to PHOTOMOD image resources and the image names appear in the Block editor window near the name of appropriate strip, and the images themselves appear in 2D window

- delete image. The image should be selected by mouse click in Block editor or 2D window.

- move image “left” (over the scheme on the screen). The image should be selected by mouse click in Block editor or 2D window.

- move image “right” (over the scheme on the screen). The image should be selected by mouse click in Block editor or 2D window.

Note: To move the group of images of the same strip, select this group using group selecting modes (see the chapter 9.10 Windows menu); then you can use also drag-and-drop mode along with pressed Ctrl key to move highlighted image or group either within the strip or the block, at that the cursor should be placed between the images

- rotate/flip image. Opens a pull-down menu allowing to rotate the selected image at 90, 180 or 270 degrees or flip it vertically or horizontally.

- image properties. Image properties include image name and quality (about JPEG compression see chapters 5.2.1 and 5.2.2).

- apply block changes. When you made all necessary operations with adding strips and images you must push this icon to finish block forming. As a result the images are finally converted to internal PHOTOMOD format.

See also the chapter 8.5 Block editor. After that you can proceed to the next project processing stage – see the chapter 4.2 Aerial triangulation.

4.2 Aerial triangulation

Use green arrow-down button in Block forming panel of Project manager window to go to the Aerial triangulation stage. On this stage you can start PHOTOMOD AT module
for aerial triangulation data collection. Block processing in PHOTOMOD AT includes interior orientation, ground control points measurements, tying strips and images (See PHOTOMOD AT User Manual). Use the icon (Project manager or the main icon panel) or Modules | AT command or hot keys Ctrl-A to start PHOTOMOD AT module. See also PHOTOMOD AT User Manual.

If your project is adjusted in some third-party software you can import the adjustment data from PAT-B, Bingo or Applanix format. In this case use the icon Import exterior orientation to import measurements from PAT-B, Bingo or Applanix format instead of starting PHOTOMOD AT (see the chapter 11.1 Import of measurements).

Note: Before starting PHOTOMOD AT you should input camera passport data to Camera editor (see the chapter 12 Catalog of cameras)

On Aerial triangulation stage you can measure tie points on images of the project in PHOTOMOD AAT module automatically. Push the button in Project Manager window or use menu command Operations | Automatic tie point measurement, see also the chapter 9.3.11 Operations with project on Aerial triangulation stage.

See also PHOTOMOD AAT User Manual.

4.3 Block adjustment

Use green arrow-down button in Aerial triangulation panel of Project manager window to go to the Block adjustment stage. On this stage you can start PHOTOMOD Solver (the icon of Project Manager or command Modules | Solver or hot keys Ctrl-R) to perform the block adjustment. Once the block adjustment is done block images in 2D window are oriented in geodetic coordinate system. Names of stereopairs appear in the Block editor window. You can start the block adjustment procedure for selected part of the source block. Select the strips and images intended for adjustment using Block editor window, see the chapter 8.5 Block editor.

The icons (Import adjustment results) and (Export to PAT-B) are used to exchange adjustment data with third party software (see the chapter 11.2 Export to PAT-B format and 11.3 Import of adjustment results). See also PHOTOMOD Solver User Manual.

In case of huge blocks (containing more then 1000 images) you can perform their adjustment without visualization of graphic results, that allows to reduce processing time. Use the icon (Start Solver in batch mode) to start the process, after completion the adjustment report will be opened, see the appropriate User Manual.

If you try to pass to Block processing stage without adjustment results, you get the message suggesting either to start PHOTOMOD Solver module, or to adjust the project automatically and pass to processing, or to do nothing:
4.4 Block processing

Use green arrow-down button in Block adjustment panel of Project manager window to go to the Block processing stage.

This stage is used to start following modules of PHOTOMOD system:

- **PHOTOMOD StereoDraw** – 3D feature extraction over a stereopair (the icon of the main panel or Block editor window or hot keys Ctrl-S)
- **PHOTOMOD StereoVectOr** – parallel work with a map of PHOTOMOD VectOr format in StereoDraw (3D vectorization) and VectOr (map editing) windows (the icon of the main panel or Block editor window or hot keys Ctrl-O)
- **PHOTOMOD DTM** – building and editing TIN and contour lines over a stereopair (the icon of the main panel or Block editor window or hot keys Ctrl-D)
- **PHOTOMOD Mosaic** – making orthophotomaps (the icon of the main panel or Block editor window or hot keys Ctrl-M)
- **PHOTOMOD VectOr** – creating and printing digital maps (the icon of the main panel or hot keys Ctrl-V)

For projects referenced to geodetic coordinate system (in WGS 84) and that are on Block processing stage you can perform the following operation. Select menu command Service | Show in Google Maps to open Google Maps web site (maps.google.com) in web browser.
window, where the image of current PHOTOMOD project territory is shown. Coordinates of the image center are geodetic coordinates of cursor in 2D window of PHOTOMOD Montage Desktop module.

Prior to starting PHOTOMOD StereoDraw, PHOTOMOD StereoVector or PHOTOMOD DTM modules you should select a stereopair you need, if you go on processing the project opened in Montage Desktop. The stereopair may be selected directly in 2D window (in this case stereopairs borders must be displayed using Layer Manager) or in the Block editor window. See also the chapter 8.5 Block editor and User Manuals for PHOTOMOD modules listed above. Besides, you could start all abovementioned modules and PHOTOMOD Vector without any project, that allows you to view and edit vector and other types of objects, see the chapter 4.5 Start PHOTOMOD Montage Desktop without project.

4.5 Start PHOTOMOD Montage Desktop without project

You can open PHOTOMOD Montage Desktop module without loading any project, that allows to load or import vector objects to 2D window or open them in 3D window from any project for viewing or editing.

When working without project, two additional items are shown in Service menu: the command Recalculate working area and the option Automatically recalculate working area. These tools are used to turn off recalculation of borders of the project working area while loading/changing objects in 2D window. This area is recalculated automatically after each change to refresh 2D window content, and you can clear the option Automatically recalculate working area to speed up the actions with big data volumes. If you prefer to start the operation manually select menu command Service | Recalculate working area.
If PHOTOMOD system is opened without project pre-regions in PHOTOMOD Montage Desktop module are not created and Pre-regions layer in Manager window does not exist, see also the chapter 9.8 Pre-regions menu.

5. New project

To create a new project use Project | New menu command or the icon while PHOTOMOD Montage Desktop launching, see the chapter 2 Installation and starting of PHOTOMOD Montage Desktop. The system opens a dialog (Fig.4) allowing to select a project type (see the chapter 5.1 Project types) as well as its name and description. Refer to the chapter 6 Coordinate systems about project coordinate system selection.

5.1 Project types

PHOTOMOD system works with two types of project (based on the source image geometry) – Central projection (to process aerial or space images, obtained by photo camera, see the chapter 5.1.1 Central projection) and Scanner survey (to process images, obtained by scanner, see the chapter 5.1.2 Scanner survey).

If the initial data is acquired by digital camera ADS 40, you should select the project type ADS 40, see the chapter 5.1.4 ADS 40 project.

![Fig.6 Project creation window](image)

5.1.1 Central projection

Central projection (images obtained by photo camera) projects are divided into two subtypes – Block (block of images) and Single image (one image). Image adding panel is used to select and add images to the project (see the chapter 5.2.1 Adding central projection image to the project). For blocks of images you may perform total photogrammetric processing by using all system modules. In case of a single image you can make its interior
orientation, georeferencing by ground control points (PHOTOMOD AT), adjustment in PHOTOMOD Solver. Then you can orthorectify the input single image, using some imported external DEM (PHOTOMOD Mosaic).

5.1.2 Scanner survey

Projects of Scanner survey type are divided into two sub-types – Monoblock and Stereoblock.

If the set of scanner images has minimal overlap and does not form a stereopair, you should create new PHOTOMOD project as Monoblock type. At that images block should be divided into strips during input, see the chapter 5.1.2.4 Processing of scanner images in Monoblock project.

Single scanner image should be processed in project of Monoblock type, see the chapter 5.1.2.3 Single space image processing.

In case of stereopair or set of stereopairs of space images, they should be processed as Stereoblock project type. At that each stereopair should be input as an individual strip, see the chapter 5.1.2.5 Processing of scanner images stereo blocks.

Three different ways are used in PHOTOMOD system for scanner data processing. The first one considers sensor parameters and applies “rigorous” algorithm for the image processing, and therefore provides the resulting accuracy within the image resolution (by RMS on GCP). In that case it is possible to input less GCP and obtain higher accuracy while calculating the exterior orientation parameters. Now this methodology is realized for the following types of scanner images: SPOT (preprocessing level 1A, SISA, CAP and DMAP formats), ASTER (preprocessing level 1A, HDF format), EROS (RAW format) and FORMOSAT-2. See also the chapter 5.1.2.2 Number of GCP necessary for space images processing in PHOTOMOD.

The second scanner data processing mode called Generic is more “universal”. It uses the DLT (Direct Linear Transformation) or Parallel-perspective algorithm and allows to input any scanner images (including IRS, LandSat, etc.) to PHOTOMOD system, converted previously into TIFF format or “directly” (for IRS imagery). You can process any scanner images using the generic mode however in this case you have to have a big enough number of control points (at least 10 per image).

Besides, for IKONOS (GEO level, TIFF/GeoTIFF format, with RPC) and QuickBird (Basic or Standard Ortho Ready level, with RPC) and OrbView-3 imagery processing you should use the generic algorithm, considering those additional parameters (RPC). At that, if RPC for IKONOS, QuickBird and OrbView-3 images are available you can achieve precise photogrammetric results using less GCP. If there is no RPC, use more GCP to increase accuracy. For more details about processed imagery formats refer to the chapter 5.1.2.1 Scanner imagery formats.

Survey systems supported in PHOTOMOD

<table>
<thead>
<tr>
<th>Survey system</th>
<th>Processing algorithms</th>
<th>Stereo processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPOT 1-5</td>
<td>Rigorous, generic</td>
<td>Yes</td>
</tr>
<tr>
<td>IRS 1C, 1D</td>
<td>Generic</td>
<td>Yes</td>
</tr>
<tr>
<td>IRS P5 (CARTOSAT-1)</td>
<td>RPC, generic</td>
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<tr>
<td>IRS P6 (RESOURCESAT-1)</td>
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<td>Project</td>
<td>Algorithm</td>
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</tr>
<tr>
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<td>-------------------</td>
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<tr>
<td>EROS A</td>
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<td>FORMOSAT-2</td>
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<td>KOMPSAT - 2</td>
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<tr>
<td>GeoEye – 1</td>
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<tr>
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<td>ALOS (AVNIR 2)</td>
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<td></td>
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<tr>
<td>Other</td>
<td>Generic</td>
<td></td>
</tr>
</tbody>
</table>

Note. For scanner projects processing you should input only GCP with X, Y, Z coordinates

Note. PHOTOMOD’s rigorous algorithm works with ASTER and SPOT images of 1A pre-processing level that includes just a radiometric correction; ASTER and SPOT images of 1B level could be processed by generic algorithm

5.1.2.1 Number of GCP necessary for space images processing in PHOTOMOD

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Project type</th>
<th>Monoblock</th>
<th>Stereoblock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigorous</td>
<td>GCP</td>
<td>Recurs DK – 6 (points per image) FORMOSAT -2 – 4-6 EROS A,B – 4-6 KOMPSAT-2 – 4-6 SPOT 1-4 – 4-6 SPOT 5 – 4 TERRA/ASTER – 4-6</td>
<td>KOMPSAT-2 – 4-6 SPOT 1-4 – 4-6 SPOT 5 – 4 TERRA/ASTER – 4-6 points per image (the number can be reduced by means of tie points, measured in the triple or quadruple overlap)</td>
</tr>
<tr>
<td>Check</td>
<td>3-5</td>
<td>1-2 (not less then 5 for block)</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----</td>
<td>---------------------------------</td>
<td></td>
</tr>
<tr>
<td>Tie</td>
<td>3-4 in double overlap area, if there is triple or quadruple overlap – measure some points there</td>
<td>3-4 in quadruple overlap</td>
<td></td>
</tr>
</tbody>
</table>

### RPC

<table>
<thead>
<tr>
<th>GCP</th>
<th>QuickBird - 1-4</th>
<th>GeoEye-1 – 1-4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OrbView-3 – 1-4</td>
<td>IKONOS - 1-4</td>
</tr>
<tr>
<td></td>
<td>WorldView-1 – 1-4</td>
<td>KOMPSAT-2 – 4-5</td>
</tr>
<tr>
<td></td>
<td>GeoEye-1 – 1-4</td>
<td>Cartosat-1 (IRS P5) – 4-5</td>
</tr>
<tr>
<td></td>
<td>IKONOS - 1-4</td>
<td>ALOS (PRISM) – 1-4</td>
</tr>
<tr>
<td></td>
<td>KOMPSAT-2 – 4-5</td>
<td>points per image (the number of GCP points can be reduced by means of tie points, measured in the quadruple overlap)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check</th>
<th>3-5</th>
<th>1-2 (not less then 5 for block)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tie</td>
<td>3-4</td>
<td>3-4 in quadruple overlap</td>
</tr>
</tbody>
</table>

### Generic

<table>
<thead>
<tr>
<th>GCP</th>
<th>Landsat 7/ETM+</th>
<th>Landsat 7/ETM+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IRS-1C, 1D/PAN</td>
<td>IRS-1C, 1D/PAN</td>
</tr>
<tr>
<td></td>
<td>IRS P6 (Resourcesat-1)</td>
<td>IRS P6 (Resourcesat-1)</td>
</tr>
<tr>
<td></td>
<td>ALOS (AVNIR 2) 7-10 per image - minimum with which you can start adjustment</td>
<td>ALOS (AVNIR 2) 7-10 per image - minimum with which you can start adjustment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check</th>
<th>5-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tie</td>
<td>Could be not measured</td>
</tr>
</tbody>
</table>

5.1.2.2 Scanner imagery formats

Note. While adding scanner image to the project, just select the path to the target folder with imagery and product metadata files obtained from the data supplier. PHOTOMOD system will recognize needed format and the image will be opened automatically
### Algorithms

| Rigorous – using rigorous sensor model | Resurs DK  
FORMOSAT-2  
KOMPSAT-2  
SPOT 1-5  
TERRA/ASTER  
EROS A,B | TIFF  
DIMAP  
TIFF/GeoTIFF  
CEOS (SISA, CAP),  
DIMAP  
HDF  
RAW |
|---|---|---|
| Generic (DLT and its modifications) | GeoEye-1  
IKONOS  
KOMPSAT 2  
QuickBird  
OrbView-3  
WorldView-1  
Cartosat-1 (IRS P5)  
ALOS (PRISM) level 1B1 | TIFF/GeoTIFF(+RPC)  
TIFF/GeoTIFF(+RPC)  
TIFF/GeoTIFF(+RPC)  
TIFF/GeoTIFF(+RPC)  
TIFF/GeoTIFF(+RPC)  
Orthokit  
CEOS |
| RPC – using RPC coefficients | Landsat 7/ETM+  
IRS-1C, 1D/PAN  
IRS P6 (Resourcesat-1)  
ALOS (AVNIR 2) | TIFF/GeoTIFF, HDF  
Super Structured, HDF,  
Fast C  
Super Structured, HDF,  
Fast C  
CEOS |

Any scanner images preliminary converted into TIFF or JPEG format could be processed in current PHOTOMOD version using generic algorithm (see the chapter 5.2.2 Adding scanner image to the project).

### 5.1.2.3 Single space image processing

PHOTOMOD system supports the processing of single scanner image in **Monoblock** type of project.

After opening the dialogue of the new project creation you should input its name, choose the project type **Monoblock** and coordinate system as described in the chapter 5 New project. Push OK and select the storages for the project resources storing.

Then push the button ![add images](add images) to add the image in 2D window of Montage Desktop module (see the chapter 5.2.2 Adding scanner image to the project). After that image name is shown in the **Block editor** window and the image appears in 2D window.

**Note. After images adding to scanner monoblock project they will be NOT rotated automatically like in scanner stereoblock project**
After adding of single image to the project use green arrow-down button in Block forming panel of Project manager window to go to the Aerial Triangulation stage to measure ground control points on the image (see the chapter 4.2 Aerial triangulation).

Monoblock processing in PHOTOMOD AT module and its further adjustment in PHOTOMOD Solver are described in the appropriate User Manuals. After scanner block adjustment you can build orthomosaic in PHOTOMOD Mosaic module. For Stereoblock its stereo processing in appropriate PHOTOMOD modules is provided.

5.1.2.4 Processing of scanner images in Monoblock project

Scanner space images on the same territory but without stereo overlap are processed in PHOTOMOD system in project of Monoblock type.
The procedure of images adding to the project is the same as described in the chapter 5.1.2.4 *Processing of scanner images stereo blocks*. I.e. adjacent images of images set are added to strips and processed as images block.

**5.1.2.5 Processing of scanner images stereo blocks**

*PHOTOMOD* system supports the processing of scanner imagery combined into stereo blocks acquired by remote sensing space systems. After opening the dialogue of the new project creation, input its name, choose the project type *Stereoblock* and coordinate system as described in the chapter 5 *New project*.

Push OK and select the storages for the project resources storing, then input images strips in 2D window of Montage Desktop module and add the images there. To setup the strip push the button (add strips) in main menu (see the chapter 4.1 *Block forming*).

Then push the button (add images) to add the image to the selected strip (see the chapter 5.2.2 *Adding scanner image to the project*). After that images names is shown in the Block editor window under the name of the appropriate strip, and the images of scanner block themselves appears in 2D window.
After adding images to the project use green arrow-down button in Block forming panel of Project manager window to go to the Aerial Triangulation stage to measure ground control points and to tie strips and images of the block (see the chapter 4.2 Aerial triangulation).

Stereo blocks processing in PHOTOMOD AT module and their further adjustment in PHOTOMOD Solver are described in the appropriate User Manuals. After scanner block adjustment you can build orthomosaic in PHOTOMOD Mosaic module. For Stereoblock its stereo processing in appropriate PHOTOMOD modules is provided.

Note. Processing of scanner images stereopairs acquired by OrbView and EROS sensors is not provided in current PHOTOMOD version

5.1.3 Merging projects

You can organize working with some big blocks of images (acquired by photo cameras) in such a way that several operators will process different parts of images block (single strips for example) independently on the stage Aerial Triangulation (see the chapter 4.2 Aerial triangulation). In this case you have to create and process several projects and then merge them into one project for further adjustment and processing. To combine images projects select the project type Merge projects in the New project window (see the chapter 5.1 Project types). You should also set the output project name and select the coordinate system. Push OK to open Merging projects window.
Note. Projects intended for merging should be on Aerial Triangulation processing stage, i.e. Block forming stage should be passed

**Merging projects** window contains following buttons:
- **Add** – adding project to the list for merging
- **Delete** – removing project from the list for merging
- **Move up** – moving project up in the block scheme (see the chapter 8.5 Block editor)
- **Move down** – moving project down in the block scheme (see the chapter 8.5 Block editor)
- **Merge** – starting projects merging
- **Cancel** – canceling merged project creation

**Note:** Corresponding images of the source blocks must have overlapping areas; nevertheless the source projects must not contain the same images

**Note:** merged project is updated only with data obtained during Aerial Triangulation processing stage in PHOTOMOD AT module.

5.1.4 ADS 40 project

Images acquired by the airborne digital sensor ADS 40 produced by Leica Geosystems, Switzerland, could be processed in PHOTOMOD system using the following way.

**Workflow of ADS 40 data processing using PHOTOMOD system**

The workflow includes using of GPro (Leica company) and ORIMA (L. Hinsken) software along with PHOTOMOD system. You should use GPro of version 3.2.1 and ORIMA of version 9.1.

Images of Level 1, created in GPro software by the images of Level 0 preprocessing level should be added to PHOTOMOD project.

The project is processed in the following order (see Fig.11):

- After data loading from MM40 block to the work station, use GPro software to create images of Level 0, and measure tie points there automatically
- Use ORIMA program to adjust images block of Level 0 (with or without ground control points, in latter case using exterior orientation parameters measured on board)

- Use GPro program to create images of Level 1

- Add images of Level 1 to PHOTOMOD project, and create a variety of photogrammetric products there.

Fig. 11 Workflow of ADS 40 data processing using PHOTOMOD system

See detailed description of work with ADS 40 project in PHOTOMOD system below. Refer to GPro and ORIMA software User Manuals to learn about the appropriate procedures.

1. Creation of ADS 40 project

Create the project of **ADS 40** type (ADS 40 images block).

If the project created contains at least three points with known ground coordinates, which will be measured on stereopairs, you are allowed to use local coordinate systems of **Cartesian** type (left or right). Otherwise process the project in **Projected** (UTM etc.) or **Topocentric horizontal** types of coordinate systems (see the chapter 6.1 Selecting coordinate system).

Such coordinate systems restrictions are connected with coordinate system **Local Space Rectangular (LSR)**, in which exterior orientation parameters of ADS 40 sensor are supplied. The restrictions mentioned above, provide associating the coordinate system in PHOTOMOD project and **LSR**.
2. Adding data to the project

Since project adjustment is performed by external software, it is unreasonable to add a big number of ADS 40 images to PHOTOMOD project. You may use the following tricks at that:

- add (into one strip, to create stereopair) nadir and one of oblique images (at that the image acquired forward along pass is preferable, since it allows to get more ratio of survey basis to height, that is important for DEM creation); orthoimage is better to build over nadir image;
- add (into one strip, to create stereopair) two oblique images; at that you achieve the most big ratio of survey basis to height;
- add two oblique images into one strip, and nadir image into another one. At that first two images generate stereopair with more ratio of survey basis to height, which is used for DEM building. You may create orthoimage over nadir image and DEM, built using oblique images.

The following initial data files are used at adding of ADS 40 images to PHOTOMOD project:

- metadata file for Level 1 image (support-file, *.sup). The file contains parameters of LSR coordinate system, and also parameters of association of points coordinates “on-ground” in LSR coordinate system with their coordinates on Level 1 image;
- file with interior orientation parameters (calibration) of sensor (*.cam);
- files containing adjusted (*.odf.adj) and in-flight (*.odf) exterior orientation;
- image description file (*.ads) containing the list of the raster (super-tile) files that compose the image;
- raster file or files (*.tif) which are the entire image or its parts (super-tiles) in accordance with the image description file.
The appropriate files are automatically searched starting from *.sup files found in the folder selected by the user. The other files are collected using references (absolute path) from the files that are already found. So user is not allowed to move files or folders created by GPro and ORIMA software, because otherwise the file search fails. The only exception is the *.sup files which can be placed in any folder, and user can add ADS 40 imagery starting from it.

3. ADS 40 project processing in PHOTOMOD system

Processing of this type of project includes three stages: Block forming, Aerial triangulation, and Block processing.

On Block forming stage you should add images to the project using the same window as for scanner space images (see the chapter 5.2.2 Adding scanner image to the project), including radiometric preprocessing procedure (see the chapter 5.2.2.1 Image radiometric correction).

On Aerial triangulation stage you should measure tie points on stereopairs. You can also measure ground control (GCP) and check points, which are used to verify adjustment results and to correct them for PHOTOMOD system. Besides, GCP are necessary if the project has coordinate system of Cartesian type (left or right).

Then when passing to Block processing stage, you get the window containing the results of adjustment verification and data loading correctness (see Fig.13). Push the Adjustment button in this window to start building of images mathematical models using data loaded to project. After that the report with these models verification results appears. Push the button Write report to save the report to text file. Use the button Write project to save created models to the project and to pass it to the next processing stage. The Exit button closes the window.

![Fig.13 Passing from Aerial triangulation to Block processing stage for ADS 40 project](image)

Further project processing on Block processing stage is the same as for projects of other types: you can perform stereo vectorization, DEM building and orthophoto creation using different modules of PHOTOMOD system.

5.2 Adding image to the project
While creating new project you should add images to it. To add the image push the button \( \text{+} \) in \textbf{Block forming} toolbar or in \textbf{Block editor} window (open it by the command Windows | Block editor or by main panel icon \( \text{} \), see the chapter 8.5 \textbf{Block editor}). After that you will get the panel for initial file selection. Work in it depends on project type, which was chosen on previous stage (see the chapter 5.1 \textbf{Project types}). \textsc{Photomod} system has extended abilities for remote sensing data processing of different types and formats. Therefore in order to consider extreme image's features and surveying parameters, \textsc{Photomod} works with them differently from the very beginning. That is why if the project was created for airborne images processing (project type – central projection), refer to the chapter 5.2.1 \textbf{Adding central projection image to the project}. If the initial data are scanner space borne images, see the chapter 5.2.2 \textbf{Adding scanner image to the project}.

5.2.1 Adding central projection image to the project

While adding images to the new project with \textbf{Central projection} type, you will get the panel for initial selection of images (Fig.14), where you should select source folder (left window) and image file (the right one). If you need to select file's group use standard Windows facilities – mouse click along with pressed Shift or Ctrl buttons. In much the same way you could select images for new project from existing \textsc{Photomod} resources, using another tab.

![Image of the interface for adding images to a project](image)

**Fig.14 Airborne image adding to the project**

Initial images to be added from file may have the following raster formats:
- **Tag Image File Format (TIFF)** – TIFF and GeoTIFF format (containing special parts (“tags”) for raster georeferencing information)
- **Windows Bitmap File (BMP)** – 4-bit palette images input is also supported
- **\textsc{Vecr} Raster Maps (RSW)** – raster formats of \textsc{Photomod} \textsc{Vecr} module
- **ERDAS IMAGINE (IMG)** – ERDAS system raster format
- **NITF (NITF)**
- **JPEG (JPEG)**
- GIF (GIF)
- PNG (PNG)
- PCIDSK (PIX) – raster format with georeference in the heading developed by PCI Geomatics company
- JPEG2000 (JP2) – raster format with jpeg-compressing and georeference information in its header, output image in this format will have volume limited up to 500 Mb
- USGS DEM (DEM).

You can compress an initial image while adding it to the project, using the Compression option. There are two compression algorithms: LZW (without loss of image quality) and JPEG. For JPEG compression you can change compression level using arrows in field . At default compression level (80%) the image will be 5-7 times less in volume and in most cases it would not result in adjustment accuracy so much.

Use the JPEG-compression option and the Quality parameter to reduce the initial image.

Mark the Show checkbox to turn on preview of adding image and use the Scale slider to zoom preview.

When all necessary images are selected, push the Add button to complete the procedure.

You can also open PHOTOMOD Explorer panel for convenient viewing and managing of PHOTOMOD resources and projects using the icon (see PHOTOMOD Overview). The icon is used for files and folders list refreshing after some change applying.

When the adding procedure is completed the names of added images appear in the Block editor window near the name of their strip. To finalize the first stage of PHOTOMOD project processing, push the icon Perform raster adding after that the images will be visualized in 2D window. See also the chapter 5.2.2 Adding scanner image to the project.

Then you can pass to the next project processing stage – see the chapter 4.2 Aerial triangulation.

5.2.2 Adding scanner image to a project

Scanner images acquired by different sensors have different formats and could be delivered as a file set, which include both images themselves and files with supplementary information, used for their processing. Such sets of files obtained from a remote sensing data supplier and relevant to the images are called product.

For more details on scanner imagery formats processing in PHOTOMOD system, see the chapter 5.1.2.1 Scanner imagery formats.

Thus, imagery folder provided by data supplier would contain metadata files of different formats, associated with the images.

While adding images to the new project with Scanner survey type, you will get a new window with two tabs for initial selection of files (Fig.15). You should select source image folder containing image product files set on the first tab Select folder.

Then open the second tab to select and add the images themselves.
The upper part of this tab consists of three windows: **Products**, **Product files** and **Product images**.

![Image of Montage Desktop window](image)

**Fig.15 Scanner image selection and adding (by the example of IKONOS image)**

In the **Products** window imagery **products** and their following data are displayed in proper table columns: product identifier, provided by the data supplier, product type, its format and number of images composing the product. In the **Type** column you can see sensor type and preprocessing level of IKONOS or QuickBird images for any kind of scanner projects.

**Note. It is not recommended to change the initial file names (product identifier, provided by the data supplier, shown in Products window) using standard OS Windows tools, for instance, since it may cause failure of further work with the image, because other files relevant to this product may be linked to initial file name.**

**Product files** window contains the list of all files delivered along with the image and used for its processing. In table columns additionally to files names, their path, size and extension type are shown.

**Product images** window contains the list of all images in the product as well as their width and height in pixels. When you select an image in this window, it will be displayed in preview window if the **Show** option is on. You can also change selected file’s name (inner name in **PHOTOMOD** system) in **Name** field of **Parameters** panel, and also set up the compression coefficient for raster or invert it (from positive to negative), using appropriate options in **Parameters** panel.
Note. You should change the image name if its length exceeds 32 symbols, at that it is recommended to remove the beginning of the name and to leave the ending, which could contain the number of the image in the product files set.

When all necessary images are selected, push the Add button to complete the procedure.

If the source raster has more than 8 bits per sample (in images acquired by IKONOS or QuickBird sensors for instance), it is recommended to perform dynamic range adjustment procedure before image adding to PHOTOMOD project (see the chapter 5.2.2.1 Image radiometric correction).

The icon is used for files and folders list refreshing after some changing.

After the adding procedure is completed the names of added images appear in Block editor window near the name of their strip, after that the images will be visualized in 2D window.

Note. Due to along-track stereopair acquisition mode, IKONOS images are physically located above and below each other, and in case of IKONOS stereopair they will be rotated by 90 degrees automatically to be located as left and right. But if something is wrong, you can rotate images “manually” using the button on “Block forming” and “Block editor” toolbar. At that the first added image becomes left and the second one – right (see the chapter 4.1 Block forming).

See also the chapter 5.2.1 Adding central projection image to the project. After that you can pass to the next project processing stage – see the chapter 4.2 Aerial triangulation.

5.2.2.1 Image radiometric correction

Images, to be added to PHOTOMOD system, often are not tuned enough for their comfort viewing and processing. This may be caused by the optical features of survey equipment, radiant energy converter, analog-digital converter, etc. Such images require preliminary radiometric processing to improve their visual features. Besides, the data acquired by some sensors (IKONOS, QuickBird, Cartosat), is supplied in format of 10-12-bit per channel. For further processing in PHOTOMOD system it should be transferred to 8-bit per channel format.

At that the system will ask you to perform dynamic range adjustment procedure of selected image automatically, after pushing the Add button while image selection process in the Image adding window (see the chapter 5.2.2 Adding scanner image to the project). If you would not like to correct images radiometrically, push the No button in the dialogue shown below:

and the image will be added without histogram changing.

However it is recommended to perform radiometric correction in the window opened by pushing the Yes button.

The same Radiometric correction window is opened by pushing the button Preprocessing in Product images field in Images adding window.
The window title bar contains image name, its width, height and number of bites per pixel. While the window opens the pyramidal image is building. That pyramidal image is helpful for speed up the raster viewing in 2D window.

![Radiometric correction window](image)

Fig. 16 Radiometric correction window

*Note. Temporal pyramidal image is created in Temp subfolder in PHOTOMOD configuration folder (usually in C:\PHOTOMOD.VAR\Temp). That is why you should have enough room on hard disk, otherwise the pyramid will be not created and image visualization at 2 and more zoom will be slow.*

Temporal pyramidal image and histogram used for preprocessing of the image to be added, could be deleted after closing the Radiometric correction window, if the option **Remove pyramid and histogram after close** is on.

In the Radiometric correction window you may change the results of automatic conversion manually using tools described below.

For image scale management use the following buttons and tools, described in the chapter 8.1.1 **Zooming in / out**.

If there is more than 8 bits per channel in the image, the histogram stretching operation is applied for the whole brightness range, for each channel independently.

The following tools are used for image radiometric correction:
Operation of histogram stretching for the whole brightness range for each channel is started from the window opened by the button **(Channels)**.

![Channels window](Image)

**Fig.17 Channels order window**

*Note. The initial order of channels is setup depending on type of the image to be added*

The button **(Auto levels)** opens a window used for auto levels setup operation.

![Auto levels window](Image)

**Fig.18 Auto levels window**

The operation includes stretching the histogram of the initial image on the whole brightness range. Select necessary channel of image (blue, green or red) in the **Channels** field, and apply the next parameters of histogram stretching to them. The **Number of nodes** parameter specifies the number of intervals of intermediate feature, which is used for histogram stretching. Parameters **Trim left** and **Trim right** show a percent of histogram area to be cut off, and not be considered in the operation.

To view a histogram of the image to be added and to adjust a transfer function used to setup arbitrary brightness transformation, open a window by pushing the button **(Curves)**.
Graphically the function is visualized as a green curve. In X axis there are values of image brightness before transformation, and in Y axis – after it. Transfer function is setup using node points (small green squares). Between nodes the function line is Bezier curve with curvature degree from 0% (leftmost position of the Curvature slider) to 100% (its rightmost position). When curvature degree is 0% the function is shown as a broken line segment.

To add node point place marker to needed point of a window and press **Insert**.

To select node point just click somewhere close to it. You can move selected point by moving a mouse cursor along with pressed **Ctrl** key. Press **Delete** to delete selected point and **Esc** to cancel selection.

Use “/” and “*” keys on numeric keyboard to zoom in/ zoom out the histogram. Use **Alt-Enter** shortcut to show the histogram in full and **Alt-1** to show it in 1:1 scale.

In case of color image the transfer function is setup either for all color channels simultaneously or for each one. Use **Channels** drop-down list to select color channel to be adjusted.

To apply all changes in image window immediately mark the **Preview** check box.

Marker X, Y coordinates and histogram value for the current brightness reading in percent are shown in **Status** line in the bottom of the window.

The button [ ] opens a window **Brightness-Contrast-Gamma** used for adjusting of the corresponding features for each image channel, or for all of them at once. If the option **Live preview** is on, the image changes are applied “on-the-fly”, without pushing the **Apply** button.
Fig. 20 Brightness-Contrast-Gamma adjustment

The button opens a window used for color balancing (Fig. 21). You can shift the image balance to cyan, red, magenta, green, yellow or blue color. Resulting brightness is not changed at that. You can also shift balance of each color in numeric form −100 to 100 in the Values field.

Fig. 21 Color balance window

The button (Filters) opens a window used for improving of visual quality of initial image using it's processing by different filters.

Fig. 22 Window for image filtering

Select processing type in Filter type drop-down list from the following items:
• **Blur** – intended for dithering of initial image details
• **Gaussian blur** – kind of smoothing filter, where transfer value is not a linear function (as in **Blur**) function, but a section of Gaussian function ("bell curve");
• **Sharpen** – allows to highlight and intensify a differences between image's details
• **Sharpen edges** – alike a **Sharpen** filter but performs filtering only when brightness differences between details are exceeding some threshold. Suits very well for identifying and highlighting of objects borders which are homogeneous insight (fields, for instance), at that inner part of objects remains unchanged
• **Median** – non-linear filter intended mainly for impulse noises filtration (single pixels with unnatural brightness)
• **Sobel** – non-linear differential filter, which is the first derivative of the initial raster. Used for acquisition of contour borders on raster image.

To apply all changes in image window immediately mark the **Preview** check box.

The button .undo  (undo) cancels the last action,  redo  (redo) – redoes the last cancelled action. The button  cancels all actions performed, and undo-redo operations list depth is 10 actions.

**Note. All operations are applied to the current image state**

When you get an acceptable correction result in the preview window push the **Close** button and go back to **Adding images** dialogue – see the chapter 5.2.2 **Adding scanner image to the project**.

The procedure is not the only image enhancement/adjustment operation; other modules of **PHOTOMOD** system include brightness-contrast-gamma and color balancing procedures; the **Mosaic** module has advanced possibilities to adjust radiometry as well.

6. Coordinate systems

6.1 Selecting coordinate system

The **Select** button in **Coordinates system** panel of the **New project** window (see the chapter 5 **New project**) is used to select the coordinate system for your project. In fact selected coordinates system on the step of project creation can be changed, during the block adjustment in **PHOTOMOD Solver** module. You can also use the option **Project | Properties | Coordinate system** to change the project coordinate system. The button **Select coordinate system** opens a list of available coordinate system databases installed along with **PHOTOMOD** system. Once the database is selected you can select the coordinate system, edit its parameters (such as map projection, datum, ellipsoid, etc.) or create a new one. See also chapters 6.2 **Coordinate system database**, 6.4 **Coordinate system editing** and 6.5 **Coordinate system creating**.
Fig. 23 Coordinate system database selection

After clicking the Open button the window with coordinate’s systems list included to the selected database appears. For the quick search of needed system you can input coordinate system name or key word into Search field (Fig.24) and choose the search direction: down (the button) or up (the button) the list.

Fig. 24 Coordinate system database search

The arrow in the leftward column marks the name of the first coordinate system found.

6.2 Coordinate system database

Coordinate systems database includes a list of coordinate systems supported by GeoTIFF format used to store georeferenced raster images (standard of EPSG – European Petroleum Survey Group).
Besides the EPSG database, there are Cartesian (on the plane) and Local (the Earth is approximated by sphere) coordinate systems added. The Cartesian coordinate system is used for relatively small blocks of large scale aerial images. The coordinate systems are created separately for each zone. So if you have a project covering several zones all ground control point coordinates must be recalculated to the coordinate system of one zone. The name of coordinate system looks like NAD83 / UTM zone 30N, where NAD83 is a datum, UTM is a coordinate system, 30 is a number of zone and N is a hemisphere (north).

Select the coordinate system and push OK to assign it to the project. See also the chapter 6.4 Coordinate system editing.

### 6.3 Types of coordinate systems

Coordinate system types (the list is opened by the New button of Select reference system window, Fig.19) are as follows:

- **Geocentric** – coordinate system with the origin in the mass center of the Earth. At that Z axis is oriented to the North pole, X axis to the intersection point of Greenwich meridian and equator, and Y axis to the East
- **Latitude / longitude** – geographic (latitude / longitude / height) coordinate system
- **Local Cartesian** – coordinate system on the plane
- **Local curved** – coordinate system on the sphere
- **Projected** – coordinate system defined by the map projection
- **Topocentric horizontal** – coordinate system with the origin in the selected space point. At that X axis lies in the plain of origin meridian, Z axis lies on ellipsoid surface normal in origin, and Y axis is oriented in the following way: in left coordinate system it is Eastward, and in right – northward.

**Note.** PHOTOMOD 4.3 does not work with Geodetic coordinate systems, so if you need to process such data you should convert the ground control points coordinates to...
selected Projected coordinate system, using Geodetic calculator included to the PHOTOMOD installation kit (See PHOTOMOD Overview)

6.4 Coordinate system editing

In very most cases you need just pre-defined coordinate systems included to the database. Nevertheless PHOTOMOD 4.3 provides all necessary tools for editing coordinate system parameters. For example, if you would like to change the ellipsoid in UTM coordinate system from NAD 83 to WGS 84, do the following:
- open coordinate system database
- select coordinate system (for example NAD83 / UTM zone 30N)
- push the Edit button
- select Ellipsoid option in the opened window and push the button to the left
- select WGS-84 ellipsoid in the list appeared
- push OK
In the same way you can change all other coordinate system parameters such as datum, map projection, ellipsoid parameters and so on (see also the chapter 6.5 Coordinate system creating).

6.5 Coordinate system creating

To investigate coordinate system creation lets use the following example. Suppose you need to create a coordinate system in Transverse Mercator map projection for the area of 8th zone (origin meridian – 136 degrees) of the north hemisphere on the ellipsoid WGS-84. Then you should:
- open a window of coordinate system database selection (Project | New | Coordinate system or Project | Properties | Coordinate system)
- select coordinate system database
- push the New button in appeared window, which contains the list of available coordinate systems
- select reference system type as Projected (Select reference system type window)

- push OK
- fill out the following fields of Edit projected reference system window:
  - Name – arbitrary name (for example UTM, 8N zone)
  - Abbreviation – arbitrary short name
  - Description – arbitrary description
- **Datum** – select datum World Geodetic System 1984, (WGS 84 ellipsoid is displayed in Ellipsoid field automatically)
- **Prime meridian** – select Greenwich from the list
- **Linear units** – select Meters from the list
- **Axis names** – set names for axis as E, N, H

![Fig.27 Coordinate system parameters]

- Push the button in Map projection field and select UTM zone 8N in Select map projection window

![Fig.28 Map projection selection]
- Push OK.

When you process scanner project, which contains RPC data (with heights above ellipsoid) and does not contain ground control point coordinates, you need to recalculate height system to obtain correct results. PHOTOMOD system includes parameters of predefined geoid for such recalculation – EGM-96 (Earth Gravity Model-1996). Mark this option in the Height system panel to use this geoid to set heights in coordinate system. There is also an opportunity to set up heights using user-defined geoid, see the chapter 6.5.1 Geoid selection and editing.

You can also input map projection parameters manually in the window opened by pushing the New button in Select map projection window.

Select following parameters in Edit map projection window:

- Push the button in Projection type field and select UTM (6 degree zones) in the list appeared
- Click the hemisphere field and select N (Northern) in drop-down list
- Click the zone field and select 8 in drop-down list

![Edit map projection](image)

Fig.29 Creating map projection

Note. You should not input zone number while editing or creating map projection, since it is included to Reference system name (see Fig.27, 28)

Another way for map projection selection is using Transverse Mercator projection with full list of parameters. In this case you should set the following values in Edit map projection window:
6.5.1 Geoid selection and editing

When creating or editing coordinate system in PHOTOMOD project you can setup height system in two ways. In most cases project uses heights above ellipsoid and you should mark the option **Heights above ellipsoid** in **Heights system** panel in the window of coordinate system parameters editing, see Fig.27 in the chapter 6.5 Coordinate system creating.

In some cases (if for instance the initial project data contain RPC coefficients and does not contain ground control points coordinates), you may need to consider heights above geoid in created coordinate system. To use the parameters of predefined geoid – **EGM-96** (Earth Gravity Model-1996) check the appropriate option in the **Height system** panel. There is also an opportunity to set up heights using user-defined geoid, by the following way.

In the same **Edit coordinate system** window check the option **User-defined geoid** and push the button ... After that the window for heights system editing window is opened.
The following example shows how to edit height system (Fig. 31). Input the name of user-defined height system into the Name field (NAVD 88). If you use file with table of elevations of the geoid above ellipsoid, check the option Vertical data file in Data source panel and indicate the path to the file in the File name field. After that coordinates of geoid part extents appear in the Data grid panel. And in Cell size panel cell size of this data grid are shown. If you need to recalculate elevations table into another reference system, use the Calculator. You can view the results of elevations recalculation in the window opened by pushing the View button in Data source panel (Fig. 32).

When the editing of height system is completed, push the Save button to save the results or the Close button to exit from the window without results saving.
Fig. 32 Viewing of height system data

You can create customized geoid elevations table or set vertical shift (constant height difference between geoid and ellipsoid) by checking the appropriate option in the Create data panel.

7. Working with projects

7.1 Project management

For convenient work with available projects list use Project management window, that is opened at PHOTOMOD Montage Desktop module start (the icon , see the chapter 2 Installation and starting of PHOTOMOD Montage Desktop) or by the main menu command Project | Open/management (duplicated by the icon of the main PHOTOMOD Montage Desktop window).
Fig. 33 Project management window

The window opened contains the list of available projects and allows to sort them by name, processing stage and location (by clicking the header of the appropriate column), and also buttons and icons for the following operations with the project:

- **Open** – opens PHOTOMOD Montage Desktop window, containing selected project and closes previously opened one

- **Copy** (see the chapter 7.6 Copying project)

- **Delete** (see the chapter 7.7 Deleting project)

- **Backup** – creates backup copy of the project (see the chapter 7.4 Backup project)

- **Restore** – restores the project from backup copy (see the chapter 7.5 Restoring project from backup copy)

- **Import from 3.0** – opens the panel for selecting and importing the project from PHOTOMOD 3.0, 3.1, 3.11 format (see the chapter 7.3 Importing project)

- **Cancel** – closes Project management window

- **Refresh** – refreshes the projects list in this window

- **Add to favorites** – places name of project selected in the projects list to favorite projects list

- **Remove from favorites** – places name of project selected in favorite projects list to full list of projects

- **Show favorites only** – shows favorite projects list only

- **Project statistics** – opens the window with information about selected project (Fig. 34)
Control panel – starts an utility allowing managing PHOTOMOD resources storages (see PHOTOMOD Overview)

PHOTOMOD Explorer – starts an utility allowing managing PHOTOMOD system resources (see PHOTOMOD Overview)

Storage space control – opens the panel with information about local and network free space (see the chapter 9.3.7 Storage space control and PHOTOMOD Overview)

Image wizard – starts an utility allowing working with PHOTOMOD system images (see the chapter 12 Image wizard)

Block scheme editor – starts an utility allowing to view and edit images block scheme of the project selected (see the chapter 13 Block scheme editor)

Project properties – opens the window described in the chapter 9.1 Project menu.

7.2 Opening project

To open an existing PHOTOMOD project use a command Project | Open/management (duplicated by the icon of the main panel). The system opens Project management window with a list of available projects for opening (see the chapter 7.1 Project management). Select the project name and push the Open button.
7.3 Importing project

To import a project of PHOTOMOD 3.0, 3.1, 3.11 format select the command Project | Import from 3.0 or push the icon in Project management window (see the chapter 7.1 Project management) or the same icon in starting panel of PHOTOMOD Montage Desktop module, see the chapter 2 Installation and starting of PHOTOMOD Montage Desktop). The system opens a dialog of selecting source project folder (Project folder) and source project images folder (Images folder) as well as the coordinate system in appropriate field (see the chapter 6 Coordinate systems). Push the Import button to start import the project after its selection.

Note. Imported project will be on Aerial triangulation stage. For further processing the project should be adjusted once again on Block adjustment stage. Import of different types of the objects (3D vectors, TINs, contour lines) is possible only via exchange formats

7.4 Backup project

You can create a backup copy of selected project using the icon in Project management window (see the chapter 7.1 Project management), which opens a window allowing to setup parameters of backup creation.

The upper field of the window shows a name of project to be copied. You should select a target folder to place a project backup in Placement for the main file of the backup field. Backup copy consists of the main file with PRD extension and two folders – with project files (.dat extension) and image files (.img extension).

You may include only project resources into backup copy (by marking the Copy project data option), or only images (by marking the Copy images option), or both kinds of data if both options are ON.
If some error occurs during backup you may assign the process to continue, by marking the option **Ignore resource read error**. After that the list of reading errors opens.

Lower window contains a list of project data that could be included/excluded to/from the backup. This table shows also the number and size of each data type, total volume of resources selected to the backup and source images number if they are supposed to be included to backup (at that a total files volume in bytes is indicated in parentheses), and also processing stage of the project and its copy. Please note that free space on the target disk (selected in **Placement of the main file of the backup** field) should not be less then backup copy volume.

To select/deselect all resources types use the icons and located under the table.

You can save to backup copy only compressed images (for preview), by checking the appropriate option that would save disk space.

If the option **Copy images** is ON you can also add the initial images to the project backup (to the subfolder *.img, created in the same folder with *.prd file and *.dat subfolder). You can set the parameters of such copying by pushing the button **Select** in the opened window:

---

**Fig.35 Project backup**

<table>
<thead>
<tr>
<th>Type</th>
<th>Qty</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic project data</td>
<td>18</td>
<td>123.250</td>
</tr>
<tr>
<td>Measurement stage data</td>
<td>16</td>
<td>177.632</td>
</tr>
<tr>
<td>Block adjustment stage data</td>
<td>26</td>
<td>259.703</td>
</tr>
<tr>
<td>Basic processing stage data</td>
<td>7</td>
<td>349.592</td>
</tr>
<tr>
<td>Montage Desktop preview images</td>
<td>17</td>
<td>194.129.533</td>
</tr>
<tr>
<td>Epoxy transformed images</td>
<td>17</td>
<td>1,073,475.430</td>
</tr>
<tr>
<td>Resource backup copies</td>
<td>7</td>
<td>3,755.523</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>9,554,441</strong></td>
</tr>
</tbody>
</table>

Selected for copying:
- project resources: 204 (2,406,920,852 bytes)
- source images: 16 (2,866,383,150 bytes)

Source project stage: 3 (Processing)
Project copy will be at stage: 3 (Processing)
Here you can see project images list and select those to be included in backup copy using the icons below the list. Besides, you can copy full size images or their reduced copies only (for preview) if the appropriate option is **ON**.

Input the backup copy file name and push **OK** for copying.

The operations of project backup and project restore (see the chapter 7.5 [Restoring project from backup copy](#)) are used to transport projects on CD or DVD media or to send it by e-mail. They differ from the project copying operation (see the chapter 7.6 [Copying project](#)), which creates new PHOTOMOD project as a copy of existing one.
7.5 Restoring project from backup copy

If you need to “import” the project from its backup copy click the icon in Project management window (see the chapter 7.1 Project management). In opened dialogue window select PHOTOMOD project backup copy main file (with PRD extension).

Then the following window for restoring parameters setup is opened.

![Image of Restore project dialog]

**Fig.37 Parameters of restoring project from backup**

In **New project name** field input a new name of project, then select resources and images to be restored and push the **Execute** button. In opened window select storages for placement of project resources and push **OK** to start restoring.

See also the chapter 7.4 Backup project. The operations of backup and restoring from backup are used to transport projects on CD or DVD media.

7.6 Copying project

You can copy the project by clicking the icon in Project management window (see the chapter 7.1 Project management). In the window opened specify the parameters of copying.
Fig. 38 Project copying

Input new project name to the upper field and select the resources in the lower list to be included to the copy. Besides you can include the initial images to the copy, by checking the option Copy images. Once resources are selected push OK and select storages for new project in appeared window. This list shows also the number and size of each data type, total volume of resources selected to the copy (at that a total files volume in bytes is indicated in parentheses), and also processing stage of the project and its copy. Please note that free space in your storages should not be less than project copy volume. To select/deselect all resources types use the icons and at the bottom of the table.

The operation of project copying creates new PHOTOMOD project as a copy of existing one. It differs from project backup operation, which allows to transport the project as a file on CD and DVD media (see the chapter 7.4 Backup project and 7.5 Restoring project from backup copy).

7.7 Deleting project

The project selected in the Project list window can be deleted using the icon in Project management window (see the chapter 7.1 Project management). You can also delete project images along with the project if they are not shared with other projects by checking the appropriate option in dialogue window. Then push the Delete button to delete the project.
7.8 Pre-regions creating and editing

*Pre-regions* are arbitrary 2D vector polygons “drawn” over the block of images in PHOTOMOD Montage Desktop. You can use pre-regions to define, for example, areas of TIN creation on each stereopair, considering overlaps between strips and images in the strip. See the chapter 9.8 Pre-regions menu for details.

7.9 Building block-wide TIN

See the chapter 9.4.2 Building block-wide TIN for details about creation of a TIN for the entire block of images.

7.10 Building DEM

See the chapter 9.7.2 Building DEM for details about converting irregular TIN to regular elevations grid (DEM – Digital Elevation Model).

8. Main window of PHOTOMOD Montage Desktop

Main PHOTOMOD Montage Desktop window contains menus, icon panels and windows described in this User Manual.

![PHOTOMOD Montage Desktop main window](image)

Fig.39 PHOTOMOD Montage Desktop main window
8.1 2D window

2D window located at the left part of the main window is a basic view window of PHOTOMOD Montage Desktop. You can open several 2D windows using menu command Window | New 2D window or the icon of the main panel. 2D window displays block of images, oriented in accordance with the project stage (see the chapter 4 Stages of project processing). On the Block forming stage images are displayed in 2D window after adding to the project. On the Block processing stage images in 2D window are oriented relatively north and east directions based on the block adjustment. Besides, 2D window is used to view all other project components like stereopairs borders, numbers and names of images and so on. To show / hide them use Layer manager located at the low-right corner of the main window (see the chapter 8.3 Layer manager).

Icons of the 2D window toolbar are used for the following:

- (duplicated by “/” key) - center picture “around” marker
- (duplicated by F6 key) – turns on/off the roam mode. In this case the marker is fixed and located in the middle of the screen and you can move “underlying” image by the mouse. See the chapter 8.1.5.2 Fixed marker mode
- shows / hides scroll bars
- shows/hides panel of brightness, contrast and gamma settings at the bottom of 2D window which contains appropriate sliders, (see the chapter 3.8 Brightness and contrast adjustment)
- - allows to show / hide the Navigation window, Project Manager window, see the chapter 8.5 Navigation window and 8.8 Project Manager or both of them (Service panel item). To place the navigation window to the right / left from the view window use option Swap layout horizontally. You can also place the navigation window upper or lower than Manager by using Swap layout vertically.

The rest of buttons on 2D window toolbar are intended for image zoom management in the window, see the chapter 8.1.1 Zooming in / out.

8.1.1 Zooming in / out

The following tools of 2D window are used to zoom in / zoom out the image:

- (hot key “*”) - 1 step zoom in
- (hot key “/”) - 1 step zoom out
- (hot keys “Alt-Enter”) - fit image to window
- (hot keys “Alt-1”) - 1:1 zoom, when image cell corresponds to screen pixel

For convenient image zooming in 2D window use the following hot keys:

- Alt-2 – zoom 200%
- Alt-3 – zoom 300%
- Alt-4 – zoom 400%

The button (Preset zoom) is used to zoom the image in 2D window as described in the chapter 10 PHOTOMOD Montage Desktop settings.
You can also use a slider for zooming in / zooming out. Move the slider or input the magnification value in percent from keyboard in this window. Besides, you can zoom in by zoom box along with pressed Ctrl-Alt-Shift and zoom out by zoom box along with pressed Ctrl-Alt. For “panning” over the image move a mouse cursor along with pressed Alt key. See also the chapter 16 Hot keys.

8.1.2 Brightness and contrast adjustment

To change image brightness, contrast and gamma use sliders located at the bottom of 2D window.

A set of buttons located to the right from sliders used for adjustment of image' brightness, contrast and gamma for color channels (red, green, and blue). You can adjust the parameters either for each selected channel (the button corresponding to the channel color should be pushed), or for all channels at the same time (when the button is pushed).

To restore default BCG settings select the command Restore settings in context menu of BCG panel.

These settings are valid only for current session; you should reset them after next PHOTOMOD StereoDraw opening.

8.1.3 Scrolling and panning

While editing of vector objects you can use standard scrolling sliders in 2D window and also the following operations:

- **Pan** mode – move the mouse cursor over the image along with pressed Alt key
- load the image screen by screen (with 10 percent of overlap). To pass to the adjacent screen to the left, right, top or bottom use corresponding arrow key along with pressed Alt key.

8.1.4 Saving image

You can save the current image shown in 2D window to TIFF format (using menu command Service | Save image). At that the whole image is saved considering scale and layers settings in Manager panel.
Fig. 40 Settings of 2D window image saving

Prior to image saving, setup saving parameters in the window opened. Select preferable image resolution in dpi or adjust it to achieve needed size of the scene for its printing. Use the buttons and to zoom in/out the image to be saved.

For quick viewing and printing of saved scene use the option Open with RasterView. See the description of the RasterView window in PHOTOMOD Overview User Manual.

After pushing the Execute button the image will be saved into specified file of TIFF format. Since the entire image will be saved, not only its current 2D window fragment, you should remember that images extremely enlarged in 2D window would take quite a long time and much disk space (but not more than 4 Gb) for saving.

Such image saving is available if GDI graphics mode is selected in module preferences (see the chapter 10 PHOTOMOD Montage Desktop settings).

You can change 2D window background color used at image saving and printing (from white through grayscale to black) using a slider in module settings on the View tab, see the chapter 10 PHOTOMOD Montage Desktop settings.

If the module uses preview image you should cancel it to change background color using menu command Operations | Clear scene preview, and then push the button (Refresh windows) on toolbar, to let the color change.

8.1.5 Operations with marker

8.1.5.1 Moving marker mode

Moving and fixed marker modes are turned on/off by the icon (fixed marker) or F6 hot key. Use mouse or keys with arrows to move the marker in XY plane and PgDn, PgUp keys or the mouse wheel to move it along Z axis.
For fast marker moving along Z axis use mouse wheel along with pressed Alt key.

You can change marker shape, using Marker page on module settings page (opened by Service | Preferences menu command), see the chapter 10 PHOTOMOD Montage Desktop settings.

8.1.5.2 Fixed marker mode

Moving and fixed marker modes are turned on/off by the icon (fixed marker) or F6 hot key. In case of fixed marker the marker is always located in the center of screen.

During vectors editing you move the image in 2D window by the mouse or arrow keys (←, ↑, →, ↓) in plane and by PgDn, PgUp keys or the mouse wheel by Z.

The advantage of the mode is a smooth roam vectorization with a constant image auto scrolling.

You can change marker shape, using Marker page on module settings page (opened by Service | Preferences menu command), see the chapter 10 PHOTOMOD Montage Desktop settings.

8.1.5.3 Stream line mode

You can edit vector objects in 2D window using stream line mode – drawing the continuous line by mouse with pressed left button. To turn on such vectorization mode push the icon (Stream-line) of upper button bar or press the Y key, and place the first line point by Insert key. Release the icon or press the Y key again to quit the stream line mode.

8.1.5.4 Fixed Z mode

If you need to draw a vector line at a constant Z level use Fixed Z mode. To set a Z value, place the marker to a correct position and select menu command Edit | Fix marker by Z. You can also enter the Z value in Z field of the Marker window, see the chapter 8.2 Marker window. Release the above mentioned icon or unselect the menu option to quit this vectorization mode.

8.1.5.5 Marker geodetic coordinates

PHOTOMOD Montage Desktop provides marker moving in real (geodetic) coordinates of a project.

When marker is moving in the image plane, its real (ground) X, Y coordinates are changing while Z coordinate remains the same. When the marker moves along Z coordinate its real X, Y coordinates remain the same.

Marker geodetic coordinate values are displayed in the Status panel located at the bottom of the screen (see the chapter 8.7 Status panel) and also in the Marker window (see the chapter 8.2 Marker window).
8.1.6 Types of snapping

When working in the snap mode the marker is moved only along the existing vector objects (points, vertices or segments). It is useful when you need to create an object that spatially coincides with some existing objects. For example when you vectorize electric power line connecting existing piers (point objects). PHOTOMOD Montage Desktop provides the following types of snapping:

- **3D snapping to vertex** (the \( \text{3D} \) icon or \( \text{V} \) hot key). In this mode the marker “jumps” from one vertex to another. When you click somewhere on the image, the marker moves to the nearest vertex or point.

- **2D snapping to vertex** (the \( \text{2D} \) icon or \( \text{B} \) hot key). In this mode the marker “jumps” from one vertex to another and XY marker coordinates coincide with XY coordinates of the vertex. Marker Z coordinate at that will be preserved.

- **3D snapping to line** (the \( \text{3D} \) icon or \( \text{N} \) hot key). In this mode the marker moves along existing vector objects lines (segments) keeping all XYZ coordinates. When you click somewhere on the image, the marker moves to the nearest vector object.

- **2D snapping to line** (the \( \text{2D} \) icon or \( \text{M} \) hot key). In this mode the marker moves along existing vector objects lines (segments) just in XY plane. Marker Z coordinate at that will be preserved.

2D snapping is used when the creating object must spatially coincide with an existing one only in XY plane. For example you want to “draw” an extension to some building at the other Z level.

Hot keys listed above are used for quick setting snapping on (the key is pressed down) and off (the key is released).

When creating an object in the snapping mode you can include a part of some existing object into the object that is currently being created. As a result, two or more vector objects will have common part with vertices of different objects editable separately. For example, you can change vertices of one of the objects, while the other objects don’t get any changes.

You can create common vertices of two objects in 2D or 3D snapping to line mode, using \( \text{Alt-V} \) shortcut.

*Note. For searching of the nearest point in the snapping mode, the 2D image pixel coordinates are used*

8.2 Marker window

Marker window (opened by the icon \( \text{Marker window} \) of the main panel or by main menu command Windows | Marker window) shows current real (ground) and pixel marker coordinates. Besides viewing the values you can enter them from the keyboard and the marker will be moved accordingly after pushing the \( \text{Apply} \) button.
There are the following icons at Marker window button bar:

- **✓** - apply – moving marker in accordance with entered coordinate values
- **←** - canceling coordinate values input
- **⋯⋯** - more decimal places – increasing number of decimal places in coordinate values
- **⋯⋯** - less decimal places – decreasing number of decimal places in coordinate values

Marker coordinates entering is used for instance, for the operation of moving a point or vertex to the marker position.

**8.3 Information window**

Information window (opened by the icon of the main panel or by main menu command Windows | Information window) displays the values of coordinates, angles and distances described in the chapter 8.4 Measurements over the model. Beside the measurements mode Information window is used also for pre-regions creation, see the chapter 7.8 Pre-regions creating and editing.

If necessary you can input geodetic coordinates X, Y or Z into appropriate fields of Information window and marker will move into the point with specified coordinates after pressing Enter.

**8.4 Measurements over the model**

The mode of measurements (turned on by pushing the icon of the main panel or by selecting menu item Edit | Measure mode) is useful for some temporary stereo-measurements – when for example you need to know the height of a building or a tree.

There are exactly the same tools as for the 3D line creation – Insert key to add a vertex, PgUp, PgDn keys or mouse wheel to move marker by Z and the mouse or arrow keys to
move marker in plane. The line appeared is a temporal one: it disappears after you quit measurements mode (by releasing the same icon or turning off the menu item).

![Image of PHOTOMOD 4.4 interface](image)

**Fig. 43 Measurements in 2D window**

At that in the **Measurements** window the following values are displayed:

- **X** – marker X geodetic coordinate
- **Y** – marker Y geodetic coordinate
- **Z** – marker Z geodetic coordinate
- **Xp** – marker geodetic X-coordinate in previous point
- **Yp** – marker geodetic Y-coordinate in previous point
- **Zp** – marker geodetic Z-coordinate in previous point
- **dX** – marker geodetic delta X when drawing a “rubber line”
- **dY** – marker geodetic delta Y when drawing a “rubber line”
- **dZ** – marker geodetic delta Z when drawing a “rubber line”
- **S** – length of the current segment of the “rubber line”
- **D** – length of the current segment projection on XY plane
- **dZ/D** – the value of the current segment slope
- **ΔX** – direction of the current segment relatively to X axis
- **Δ** – direction of the current segment relatively to the previous one
- **** – vertical angle of the current segment
If necessary you can input geodetic coordinates X, Y or Z into appropriate fields of Information window and marker will move into the point with specified coordinates after pressing Enter.

For easy viewing and finding point on the block (moving the marker to the point with the corresponding geodetic coordinates) copy marker position to the clipboard with keyboard shortcut - Ctrl-Alt-Ins (with the active layer "Marker") (see the chapter 8.6 Layer Manager). To move the marker to position saved in the clipboard - use keyboard shortcut Shift-Alt-Ins.

8.5 Navigation window

The Navigation window is located at the upper-right part of the screen. It shows the entire block scheme and is used for fast moving over it. Click the place you need in the navigation window to scroll 2D window correspondingly. Green frame in the navigation window bounds the block fragment currently displayed in 2D window. You can open / close the navigation window using the icon of 2D window. See also the chapter 8.6 Layer manager.

8.6 Layer manager

Layer manager is used to show / hide different kinds of objects and layers in 2D and Navigation window (see the chapter 8.1 2D window and 8.5 Navigation window). Click the icon of 2D window and mark the Manager option to open Layer manager (actually it is open by default). Layer manager contains three tabs: Main window, Navigation and Info.

![Layer manager interface](image)

Fig.44 Main window tab of Layer manager

Click eye-looking icon of Layer manager to show / hide the following layers in 2D or Navigation window:

- **Marker** – show / hide marker. Double click on the icon opens the window for marker shape and color setup. See also the chapter 9.9 Service menu
- **Frame** – show / hide “frame” of the images block with coordinates
- **Pre-regions** – show / hide pre-regions (see the chapter 9.8 Pre-regions menu)
- **Block scheme** – show / hide following objects of the block scheme
  - **Stereopair labels** – names of stereopairs
  - **Stereopairs** – borders of stereopairs
  - **Image labels** – image names
  - **Images** – image borders
  - **Strip labels** – strip names
  - **Strips** – strip borders
- **Triangulation points** – show / hide ground control and tie points used for the aerial triangulation and block adjustment in PHOTOMOD AT and PHOTOMOD Solver modules. An additional options are as follows:
  - **Points** – show points
  - **Labels** – show numbers of points
- **Raster** – show / hide block images. Use double click on the icon (when raster layer is active) to open dialogue window where you can switch between color and grayscale viewing of color images, and also turn ON/OFF additional BCG-correction.

The layers mentioned above are opened in the Layer manager by default. In PHOTOMOD Montage Desktop you can also open additional layers containing the objects, created during project processing in different PHOTOMOD system modules. Besides you can use context menu in Manager window (the command New layer | DEM, Contours, Vector objects, TIN) to create new (blank) layer. After layer opening or creating, the appropriate layer name with some icons described below appears in Layer manager window.

Double click the icon leftward from DEM layer name, to open an additional dialogue allowing to adjust DEM transparency in 2D window using an appropriate slider. This option is available if on Visualization tab of Montage Desktop module settings the OpenGL graphic mode is ON (see the chapter 10 PHOTOMOD Montage Desktop settings).

The pencil icon , appeared after click on the empty rectangle to the left from the layer name or on the layer name itself, indicates that the layer is active and editable.

The icon leftward from the layer name is used to change layer color.

You can change the color and font of labels (names of images, strips, etc) in appropriate panel opened by double click on the icon leftward from the layer name:

![Fig.45 Text layer properties in Layer manager](image)

There are also several icons at the upper panel of first two tabs of layer manager:
- **move layer up** in the list
- **move layer down** in the list
- refresh layer list

- close layer

You can also use a context menu opened by right mouse click on the layer name on first two tabs to perform the operations listed above.

**Navigation** tab in Layer manager allows to manage the same objects and layers but in Navigation window, located usually under the Layer manager window.

**Info** tab in Layer manager contains information about each opened layer of the project.

![Info tab of Layer manager](image)

**Fig.46 Info tab of Layer manager**

Upper icons on Info tab of Layer manager are intended for the following operations:

- refresh layer list

- show information about all layers

- hide information about all layers.

### 8.7 Status panel

**Status** panel (located at the bottom of the module window) is used to display:

- current geodetic marker coordinates (on the right part). See the chapter 8.1.5.5 *Pixel and real coordinates*

- error messages or notifications about successful operations completion (on the left part).

### 8.8 Project manager
Project manager window (opened by menu command Windows | Project manager or by pushing the icon) is used to control the current project stage, switch between project stages and start the modules of PHOTOMOD system. See also the chapter 4 Stages of project processing.

![Project manager window](image)

**Fig.47 Project manager**

### 8.9 Block editor

Block editor window (opened by menu command Windows | Block editor or the icon) is used for the work with block of images on all stages of project processing. See the chapter 4 Stages of project processing.

Use the following tricks of work in Block editor window, common for all processing stages:

- If strip or image is selected in 2D window, it is selected in Block editor window and vice versa. At that Block editor will be scrolled to show the selection. If the image is selected in Block editor along with pressed Alt key, 2D window is centered on the center of the image
- Ctrl-F hot keys are used for search of image or stereopair in block by its name
- In each cell there is name of image or stereopair, and in the right lower corner – the icon showing image rotation (no icon=no rotation, icon shows rotation on 90/180/270 degrees). On Block forming stage un-added images are shown by crossed red square
- In Status bar you can see the following:
  - **Font size** field is used for font size change, which results in appropriate change of cells size (duplicated by mouse wheel rotation along with pressed Ctrl key)
  - **Strip** field shows {strip name} ({strip number}/ {total number of strips}) or [selected {number of selected} from {total number of strips}]
  - **Image** or **Stereopair** field shows the same, but without group selection for stereopairs.

### 8.9.1 On Block forming stage
Once images are input to the project on **Block forming** stage, they appear in **Block editor** window. Upper button bar of **Block editor** contains icons for managing of project images and strips. On **Block forming** stage some icons are the same as those described in the chapter 4.1 **Block forming**. The rest of icons are used for the following:

- Adjust window size – resizes the window of **Block editor** according to the number of strips and images of the current project
- Collapse/expand – allows to roll/unroll **Block editor** window for convenient work
- Preferences – opens a window of **PHOTOMOD Montage Desktop** preferences on **Block editor** page settings, see the chapter 10 **PHOTOMOD Montage Desktop settings**.
- (duplicated by Ctrl-F hot keys) - Search by name – opens a window used for image search by name in **Block editor**.
- Automatic splitting into strips – opens a window used for selecting parameters of block splitting into strips.

It is suitable to use **Block editor** to move images and strips and put them in needed order during block forming. To move the image select its cell and drag it by mouse to its place in the block along with pressed Ctrl key. To move the strip select it by mouse click on the strip name in grey column and drag it to its place in the block along with pressed Ctrl key. To delete selected image or strip use right mouse click and select command **Delete from the project** in menu appeared.

You can drag the item out of table or release Ctrl key before releasing of left mouse button to cancel any dragging.

Other hot keys are used to:
- **Shift-Del** – delete selected strip
- **Del** – delete selected images
- **Shift-Ins** – add strip
- **Ins** – add images – opens a window for images selection and adding, see the chapter 5.2 **Adding image to the project**.

### 8.9.2 On Aerial triangulation stage

**Block editor** window on **Aerial triangulation** stage looks as follows:
In addition to icons described above there are the following ones:

- Strips layout – allows to place strips in the window vertically or horizontally, this operation is also performed by double click on upper left corner cell.

- Start PHOTOMOD AT – starts PHOTOMOD AT module (with relative orientation window in it) for the current project.

- Open stereopair in PHOTOMOD AT – starts PHOTOMOD AT module for stereopair that contains both selected and the next image in strip (the button is disabled if the last image in strip is selected).

- Automatic tie point measurement – starts PHOTOMOD AAT module, where you can add tie points to the project, see appropriate User Manual.

8.9.3 On Block adjustment stage

When the project is on Block adjustment stage, Block editor window looks as follows:

Each cell contains images stereopair. Yellow cells show unselected stereopairs, green – selected ones.

In addition to icons described above there are the following ones:

- Add all images to subblock – used to select all images of the block and mark them by green color.
- Remove all images from subblock – used to deselect all images of the block and mark them by yellow color
- Invert subblock – used to invert selection in the window
- Reset subblock – cancels subblock selection and restores images set into initial state
- Save subblock – applies changes to images block and shows renewed block in 2D window
- Start PHOTOMOD Solver – starts PHOTOMOD Solver module for selected subblock or to the whole project.

If you need to adjust big images block in parts, use Block editor to select such fragments of the block – subblocks – for further processing them in PHOTOMOD Solver module. Use the following actions to select images into subblock:

- click cell with image name to specify upper left corner of subblock
- specify lower right corner of subblock by mouse click along with pressed Shift key, that also selects all images of the subblock
- when some image is selected (as an upper left corner), press Shift key and drag frame by mouse to specify lower right corner of subblock, at that Block editor window scrolls down automatically
- if you need to deselect part of subblock (or block) that is already selected, use mouse click to specify upper left corner of subblock, and click its lower right corner along with pressed Shift and Ctrl keys.

If it is necessary to adjust several different (not connected) parts of the block in PHOTOMOD Solver, use mouse click along with pressed Shift, to select subblock additionally to already selected one.

For selection of strips to subblock use the following actions:

- mouse click on the grey cell containing strip name, highlights the name of the upper strip (and all its images) of the subblock
- mouse click along with pressed Shift key on the other strip specifies the lower strip of the subblock and selects the whole subblock
- mouse click along with pressed Ctrl key on the cell containing the name of selected strip, removes it from the subblock
- mouse click along with pressed Ctrl key on the cell containing the name of unselected strip, adds it to the subblock

8.9.4 On Block processing stage

If the project is on the Processing stage, you can start different PHOTOMOD modules from Block editor window for selected images and stereopairs, to process project in them – PHOTOMOD DTM, PHOTOMOD StereoDraw, PHOTOMOD StereoVectOr and PHOTOMOD Mosaic.
Besides icons described above, the upper bar contains the button \(\text{(view as stereopairs)}\). Push it to show images as cells containing stereopairs names and icons located rightward from the stereopair name. Each of the icons indicates the existence of the following objects on the selected stereopair:

- epipolar images (stereopair is prepared for processing in PHOTOMOD Stereo Draw, PHOTOMOD DTM and StereoVectOr – see the chapter 9.3.1 Epipolar transformation)
- TINs
- contour lines
- 3D vector objects created in DTM module
- pickets
- vector objects, created in StereoDraw module for this stereopair (see appropriate User Manual)
- notes, created in StereoDraw module for this stereopair (see appropriate User Manual)
- global contours fragments (see the chapter 9.6.2 Merging contour lines)
- pre-regions (see the chapter 9.8 Pre-regions menu).

**Note. Group selection of strips on Processing stage is possible only in 2D window**

### 8.10 3D window

3D window is opened by the icon of the main panel or menu command Windows | New 3D window. It is used to view the objects currently loaded to PHOTOMOD Montage Desktop at different angles and using different colors, fillings and so on. Such objects are TINs, 3D vectors and contour lines. Each new object is added to the list of layers located at the upper right corner of 3D window.
Fig. 52 3D window

Following icons of the toolbar are used to:

- ![Zoom In](image.png) (duplicated by hot key "**") - 1 step zoom in
- ![Zoom Out](image.png) (duplicated by hot key "/" ) - 1 step zoom out
- ![Fit Image](image.png) (duplicated by hot keys "Alt-Enter") - fit image to window
- ![Restore Zoom](image.png) - restore the source zoom level, Z-scale etc.
- ![Refresh](image.png) - refresh the 3D window (after making some operations in 2D window)
- ![Rotate](image.png) - rotate model in selected direction
- ![Scale Z Pos](image.png) - increase the model scale by Z-coordinate
- ![Scale Z Neg](image.png) - decrease the model scale by Z-coordinate
- ![Perspective Inc](image.png) - increase the model "perspective"
- ![Perspective Dec](image.png) - decrease the model "perspective"
- ![Save Picture](image.png) - save the picture to BMP format
- ![Scroll Bars](image.png) - show / hide scroll bars
- ![Layers Panel](image.png) - show / hide Layers panel (see the description below)

To rotate objects in 3D window in different directions you can also use 1, 3, 4, 6, 7, 8, 9 keys of Numpad. Press 5 key to revert to start model position. Shift-"**" and Shift-"/" key combinations are used to increase/decrease model scale by Z-coordinate. To change model "perspective" (move it relatively to the screen plane) use Alt-"*" and Alt-"/" shortcuts.
At the upper right part of 3D window there is a Layers panel used to show or hide different layers – TINs, contour lines, 3D vectors etc. The icons located to the left from the layer name are used to:

- Green square - change layer color
- Grey circle - show / hide layer
- Green icon - show layer in solid color, wire frame model or points
- Green triangle - show layer by one color or colorful.

8.11 Raster map window

When working in PHOTOMOD system it is helpful to use scanned topographic map on the same terrain area, for which aerial and space images were obtained. Georeferenced map is used for images stereo processing in PHOTOMOD StereoDraw module, when you need to visualize vectorized terrain features with georeferenced map in background. Such map is also used in PHOTOMOD AT module for ground control point’s coordinates acquisition (see an appropriate User Manuals).

Scanned map (in TIFF, BMP, JPG formats) could be georeferenced using ground control points coordinates in the following window, opened by menu command Service | Raster georeferencing…

If georeference file (in MapInfo TAB format and with the same name as map file) is storing in the same folder as file with scanned map, then list of georeference points and their coordinates will be opened in Raster map window. In this list Xg, Yg are geodetic coordinates, Xp, Yp – pixel coordinates, Name – point name.
To visualize point in map window (to place marker in point’s pixel coordinates) you should push the button with point number in leftmost column N of the table.

Upper menu buttons are intended for the following operations:

- load raster map – opens dialogue of raster file selection (in TIFF, BMP, JPG formats) and its opening
- load reference map – opens a dialogue for selection and opening of referenced raster image
- load vector map – opens dialogue for selection of vector format file (PHR (PHOTOMOD resource format), DXF or Shape)
- used to manage object’s scale in the window
- show vectors – hides/shows vector objects over the raster map, if vector file is opened
- show vertices – hides/shows vector objects vertices over the raster map, if vector file is opened
- load XYZ points from file – opens dialogue of coordinates file selection (in TXT format) and opens it as a table below the map window. Point's coordinates could be loaded replacing opened coordinates or in addition to them, after an appropriate warning.
- save – saves georeferencing file in MapInfo TAB format, at that file name will be the same as map file name but with TAB extension.
- zoom management, duplicated by usual PHOTOMOD system shortcuts - /, Alt-1, *, Alt-Enter. Besides, you can use shortcuts Shift * (for simultaneous zoom in of all images in windows) and Shift / (for simultaneous zoom out of all images in windows).
- shows zoom scale in raster map window
- displays map in grayscale or color mode

For more convenient work the map could be rotated in the following ways:
- without rotation,
- turn at 90 degrees,
- turn at 180 degrees and
- turn at 270 degrees. At that raster file is not changed and the rotation is executed “on the fly”:

- clear – deletes all points (list cleanup),
- add point – measures new point coordinates on the map and adds them to the end of list. At that marker pixel coordinates are assigned to point and 0 value is assigned to geodetic coordinates (you can input them manually in appropriate cell)
- delete point – deletes the point selected in list
- re-measure – replaces pixel coordinates of selected point. At that current pixel coordinates of marker are assigned to point and saved in the list
- predict – places marker to coordinates of point selected in list
- copy coordinates to clipboard – copies coordinates of selected point to clipboard. Coordinates are in the following format "Xp Yp Xg Yg"
- paste coordinates from clipboard – pastes selected point coordinates from the clipboard in following possible formats: "Xg Yg", "Xg Yg Zg", "Xp Yp Xg Yg", "Xp Yp Zp Xg Yg Zg", where Zp equals 0.
- select color – opens standard OS Windows palette to choose point’s symbol color on the map
- decimal places number – allows to set number of decimal places in coordinates of reference points
- coordinate system – shows current coordinate system of a project, see the chapter 6 Coordinate system.

For map georeferencing you should recognize points with known geodetic coordinates on the map. Map could be referenced using only one measured point. In that case the measurement unit is considered as 1 pixel and coordinate axis are coinciding. If there are two points, the map will be scaled and rotated, in case of three points affine transformation will be applied. For accuracy control you should measure not less then 4 points.

To measure point put marker on point’s place on the map and push the button (add point) or press the A key. After that point’s name and pixel coordinates will be added to the list. Input geodetic coordinates of the point to appropriate cells manually. When fifth point is measured, coordinates measurement errors $E_X$ and $E_Y$ are calculated automatically and the result is shown in the last columns.

Use double click to select a point or to scroll an adjacent window to chosen place.

To place marker on the measured point on the image you should click on table cell with point number (in left column).

To edit coordinate value in table cell select the cell and press F2. To end editing and save coordinate press Enter, to exit from editing without coordinate save press Esc. Use arrow keys on keyboard or Tab key to place marker to the next table cell.

After completing of raster georeferencing, push the button to save georeference file in MapInfo format.

### 8.12 Block images order

You can change the Z-order of images and strips visualization in 2D window (e.g. to see areas of images obscured by other images and strips) using the following buttons of the Images order button bar (which is turned on by the command Windows | Toolbars | Images order):

- reset images order – re-arranges images and strips Z-order to the initial state
- invert images order – inverts images Z-order for the whole block
- bring selected image to front – shows selected image on top of others
- bring selected strip to front – shows selected strip on top of others
- invert images order in the selected strip – inverts images Z-order for the strip selected
- invert strips order – inverts strips Z-order in block

For images order management is suitable to use the Block editor window allowing to select images and strips (see the chapter 8.5 Block editor).
Also, make sure that in module preferences on the Raster tab in Use scene preview panel all options are clear (see the chapter 10 PHOTOMOD Montage Desktop settings). If the block is displayed as scene preview, Z-order of the images cannot be changed.

9. Main menu of PHOTOMOD Montage Desktop

The main menu and corresponding icon panel are located at the upper part of the main window and include submenus described in the chapters 9.1 – 9.8. The particular menu items become available in accordance with the current stage of project processing (see the chapter 7 Working with project).

9.1 Project menu

Project menu is used for working with the PHOTOMOD project and includes the following commands:

- **New** – opens a window for new project creation (see the chapter 5 New project)
- **Open/management** (duplicated by the icon of the main panel) – opens an additional window Project management (Fig.32) with list of available projects and also icons and buttons for managing them (see the chapter 7.1 Project management)
- **Import from 3.0** – used to import PHOTOMOD 3.0, 3.1, 3.11 projects to current version. Opens a window of project folder selection (Project folder) and project images folder (Images folder). See the chapter 7.3 Importing project.
- **Close** – closes current project and its images in 2D window
- **Stages** – shows the list of project processing stages where the current project stage is checked out and you can pass to the next (or previous) stage. There are the following project’ processing stages – Block forming, Aerial Triangulation, Block measuring and Block processing. You can also switch your project to other stages using Project manager window. See the chapter 8.8 Project manager and 7 Working with projects.
- **Project properties** – opens the window with five tabs described below.

The first one (Identification) is used to view and change project name and description, and also to set up PHOTOMOD resources location in system storages.
The second tab of Project properties window (Coordinate system) is used to change the project coordinate system (refer to the chapter 6 Coordinate systems for details). The third page Settings is used to set up the degree of epipolar transformation compression:
- without compression
- with compression quality of source images
- with specified compression quality: use slider to set up the compression degree manually from 60 to 100% (Fig.56).
See also the chapter 9.3.1 Epipolar transformation.

Fourth tab Information contains statistical data on the current project. The Statistics button used to open an additional window described in the chapter 7.1 Project management, Fig.32.

9.2 Modules menu

Modules menu is used to start PHOTOMOD system modules. PHOTOMOD modules are available for starting depending on the current stage of the project processing (see the chapter 4 Stages of project processing). The menu contains the following items:
• **Camera editor** (duplicated by the camera icon) – starts the camera editor for entering camera passport data (see the chapter 12 Catalog of cameras).

• **AT** (duplicated by the AT icon of the main panel or Project manager or Ctrl-A hotkeys) – starts PHOTOMOD AT module (used for data collection for the aerial triangulation). Project should be on Aerial triangulation stage, otherwise PHOTOMOD AT is started in read-only mode.

• **Solver** (duplicated by the Solver icon of the main panel or Project manager or Ctrl-R hotkeys) – starts PHOTOMOD Solver module (used for block adjustment). Project should be on Block adjustment stage, otherwise PHOTOMOD Solver is started in read-only mode.

• **Block adjustment view** – starts PHOTOMOD Solver module in read-only mode for viewing the block adjustment results.

• **DTM** (duplicated by the DTM icon of the main panel or Project manager or Ctrl-D hotkeys) – starts PHOTOMOD DTM module (used for DTM and contour lines building) for the selected stereopair. Project must be on Block processing stage.

• **StereoDraw** (duplicated by the StereoDraw icon of the main panel or Project manager or Ctrl-S hotkeys) – starts PHOTOMOD StereoDraw module (used for 3D feature extraction) for the selected stereopair. Project must be on Block processing stage.

• **StereoVectOr** (duplicated by the StereoVectOr icon of the main panel or Project manager or Ctrl-O hotkeys) – starts PHOTOMOD StereoVectOr (parallel work with a map of PHOTOMOD VectOr format in StereoDraw and VectOr windows) for the selected stereopair. Project must be on Block processing stage.

• **Recent** – opens sub-menu with list of the last used stereopairs of the current project in DTM, StereoDraw and StereoVectOr modules.

• **Mosaic** (duplicated by the Mosaic icon of the main panel or Project manager or Ctrl-M hotkeys) – starts PHOTOMOD Mosaic module (used for orthomosaicking). Project must be on Block processing stage.

• **VectOr** (duplicated by the VectOr icon of the main panel or Ctrl-V hotkeys) – starts GIS and desktop cartography system PHOTOMOD VectOr. The project should be on Block processing stage.

See also PHOTOMOD modules manuals and the chapter 7 Working with project.

### 9.3 Operations menu

**Operations** menu is used to perform the following operations.

#### 9.3.1 Epipolar transformation

The epipolar transformation process removes parallel parallax and produces stereopairs to be used in PHOTOMOD DTM, PHOTOMOD StereoDraw and PHOTOMOD StereoVectOr modules.

In PHOTOMOD Montage Desktop the batch mode is used for epipolar transformation of stereopairs (the project should be on Block processing stage), see also the chapter 9.3.10 Batch processing.
The process (is started by the menu command **Operations | Epipolar transformation** or by the icon) opens a dialog allowing to adjust parameters of epipolar transformation and start it either for all block stereopairs or for the selected ones. If you start modules listed above for non-transformed stereopair, its epipolar transformation begins automatically. Epipolar transformation is available for project on the **Block processing** stage.

![Epipolar transformation dialog](image)

**Fig.58 Epipolar transformation**

In **Parameters** panel of the window you can set up the following parameters of epipolar transformation: transform images already transformed or remove them (if an appropriate options are ON). To save the disk space, check the option **Do not create color images**. As a result epipolar images will be grayscale rather than color.

**Strips** and **Stereopairs** panes and the icons below them are used for selecting stereopairs for the transformation. After adjusting parameters push the **Execute** button to start transformation process or **Close** to cancel it.

After epipolar transformation operation you will see an appropriate icon-indicator near the name of transformed stereopair in **Block editor** window (see the chapter 8.5 **Block editor**). Besides, you can create epipolar images for each stereopair “on-the-fly”, without saving them on a disk, see the chapter 9.3.1 Epipolar transformation “on-the-fly”.

### 9.3.1.1 Epipolar transformation on-the-fly

**PHOTOMOD** system allows to create epipolar images during vectorization, without saving them on a disk. To perform such operation check the option **Epipolar transformation “on the fly”** on **Epipolar transformation** tab in Montage Desktop preferences (see the chapter 10 **PHOTOMOD Montage Desktop settings**). It saves disk space when processing bulky projects in **PHOTOMOD DTM**, **StereoDraw** and **StereoVectOr** modules. When the option is ON raster texture is not visualized in 3D window. If the option is OFF, the epipolar transformation of the stereopair is done prior to loading it into abovementioned modules (if the stereopair was not transformed in batch mode, see the chapter 9.3.1 **Epipolar transformation**).
9.3.2 Save block scheme

Use the command **Service | Save block scheme** to save a current block scheme (a mosaic of the block images) into a TIFF or BMP file. The process parameters are as follows:

- **Width** – number of columns in the output raster
- **Height** – number of lines in the output raster
- **Maintain aspect ratio** – changing width of the output raster causes the corresponding changing of height and vice versa.
- **Output file** – output TIFF or BMP file selection panel
- **Compression** – JPEG compression of the output file. Use the **Quality** parameter to change the compression degree. The default quality is 75 percent that decreases the output file size at 5 times approximately.

![Save block scheme dialog box](image)

Once all necessary parameters are selected, click the **Save** button to save the block scheme to TIFF or BMP file.

9.3.3 Clear scene preview

Scene preview is used for fast displaying of the block in 2D and Navigation window. The scene preview is created every time when the block stage is changed (for example when you switch from **Aerial triangulation** stage to the **Block adjustment**). After you select menu command **Operations | Clear scene preview**, resources with scene preview images will be deleted from sub-folder, located in resources of current project in folder **Processing stage data**.

Scene preview building operation takes a long time for big blocks, and also scene previews may occupy a big volume on hard disk, that is why you are recommended to manage the preview use on different stages of project processing, using **System | Raster** tab in **Preferences** window, see the chapter 10 **PHOTOMOD Montage Desktop settings**.

9.3.4 Import measurements

(See the chapter 11.1 **Import of measurements**).

9.3.5 Export to PAT-B format
This kind of export is used for data exchange with other block adjustment software (see the chapter 11.2 Export to PAT-B format).

9.3.6 Import from PAT-B format

See the chapter 11.3 Import of adjustment results.

9.3.7 Storage space control

Menu command Operations | Storage space control... (is duplicated by the icon ) opens a panel with the following information about PHOTOMOD system storages:
  - **Total** – shows total free space including remote storages, connected to the local machine at current session
  - **Local** – shows total free space in storages of local PC
  - **On the project host computer** – on computer containing current project (see also PHOTOMOD Overview).

9.3.8 Install coordinate system database

Coordinate system database is installed during PHOTOMOD system installation (see User manual Overview). Nevertheless it is possible to change the database while working in system. Use menu command Operations | Install coordinate system database to open the list of available databases (see the chapter 6.2 Coordinate system database).

9.3.9 Convert coordinates

Use Convert coordinates operation in the following cases:

1. *When PHOTOMOD project is transferred from “free model” to chosen coordinate system.* In some cases images orientation and their further processing in PHOTOMOD system modules is executing without images referencing to ground control points (without referencing to coordinate system, that corresponds the “free model” term in PHOTOMOD Solver module, see appropriate User Manual).

Free model could be created if there are no ground control points measurements before block adjustment stage. In this case you make the interior orientation and tie points measurements in PHOTOMOD AT module. PHOTOMOD Solver builds a model based only on tie points and calculates tie errors. Then you can switch to Block processing stage in PHOTOMOD Montage Desktop, build DTM’s in PHOTOMOD DTM and create 3D vectors in PHOTOMOD StereoDraw. Thus when you will get GCP coordinates, the most part of job is already done. Once you have GCPs, go back to Aerial triangulation stage and measure them on images, then switch to the Block adjustment stage and adjust the block again in PHOTOMOD Solver. After passing Block processing stage all your TINs and 3D vectors will be transformed from “free model” to the selected geodetic coordinate system. When you input TINs and 3D vectors in PHOTOMOD StereoDraw and PHOTOMOD DTM modules, they will be transformed to the selected coordinate system automatically.

If you need to control the converting process or perform it manually, use Operations | Convert coordinates command in PHOTOMOD Montage Desktop module to open the following window:
Fig. 60 Converting coordinates

Here you should select input resource in the appropriate field of Source data panel and output resource in Output data panel. At that coordinates will be converted only via pixel coordinates (check this option in Transformation type panel). See other options description below.

2. When you have to re-adjust images block in PHOTOMOD AT module and re-link vector objects, extracted on Block processing stage to newly obtained GCP (in the same project).

3. If you have different projects created for the same territory but adjusted in PHOTOMOD AT module with different parameters and like to load vector objects created in one project to another. At that coordinates will be converted only via geodetic coordinates (check this option in Transformation type panel). See other options description below.

Source points type – to select initial points source:
- **geodetic** (mainly used) – when imported points have geodetic coordinates XYZ (measured on map or received from GPS-device etc.);
- **unknown stereopair** (mainly used) – when point is measured in stereo mode but its stereopair number is unknown or if different points are measured on the different stereopairs. At that the stereopair which has the center closest to this point will be used for transferring via pixel coordinates;
- **current stereopair** – if the point is measured in stereo mode and its stereopair number is saved in initial resource (could be applied only to some resources saved from PHOTOMOD DTM module or obtained by this convert coordinates procedure);
- **fixed stereopair** – when point is measured in stereo mode and its stereopair number should be input manually in lower field as images codes pair "left_code–right_code".

Transformation type – to select coordinates converting mode:
- **by point type** – allows to convert coordinates according to the point type: for geodetic via geodetic coordinates, and via pixel ones for the rest (see below);
• **pixel coordinates** – allows to convert coordinates in such a way that point’s XY coordinates on selected stereopair (according to the option **Source points type** for **geodetic** use **unknown stereopair**) on initial and resulting block will coincide;

• **real coordinates** – allows to convert coordinates in such a way that numerical geodetic point’s coordinates XYZ on initial and resulting block will coincide.

**Output data** – to assign output data format:

**Coordinate system** – allows to select coordinate system type for output data coordinates:

• **no changes** (mainly used) – allows to leave initial coordinate system type;

• **pixel** – allows to preserve XY point coordinates measurements on the image of “base stereopair” (see below);

• **geodetic** – allows to preserve XYZ point coordinates in geodetic coordinate system;

• **internal** (mainly used for the central projection projects) – allows to preserve XYZ coordinates in Cartesian system assigned to the block.

When using pixel coordinates for conversion (see **Transformation type** option) it is recommended to use inner or pixel coordinate system. When converting via geodetic coordinates – geodetic. The reason is that coordinates conversion between geodetic and pixel or inner coordinates system realize with 0,0001–0,001 m accuracy and additional re-calculation decrease measuring accuracy. Coordinates between pixel and inner systems are transferring with high accuracy (10^{-9}–10^{-6} m). Later on at loading the resources to **DTM**, **StereoDraw** and other modules the coordinates will be transferred between mentioned coordinate systems automatically as required.

**Base stereopair** – to assign stereopair number when using **pixel** coordinate system (see above):

• **no changes** – to use the same stereopair where the initial points were measured. If this stereopair does not exist in the result block (converting coordinates for different projects) or if the initial points were measured in geodetic or inner coordinate system you will get converting error;

• **fixed** – to input stereopair name in lower field as images codes pair “left_code-right_code”, also it is possible to select stereopair name from the list using the button **... Select**.

### 9.3.10 Batch processing

The batch mode is used to run operations identical for the selected dataset. The example of using the batch mode is the epipolar transformation applied to the selected images (see the chapter 9.3.1 **Epipolar transformation**) and TIN creation (see the chapter 9.4.1 **TIN creation in batch mode**). The batch mode is also applied for export/import of the vector objects (pickets, vectors and contours) via DXF format and for export of DEMs to CSV format.

To start export to DXF file use main menu command **Operations** | **Batch export to DXF**, which opens the window to select stereopairs and their resources for export:
In lower drop down list select object type for export (pickets, vectors, contour lines or StereoDraw vectors) then indicate the path and target folder in appropriate field and at last, select in upper window stereopairs and their resources to be exported. Then push OK to export of all the resources selected to DXF file.

When importing resources from DXF use main menu command **Operations | Batch import from DXF**, which opens the window:

Fig.62 Batch import of vector objects from DXF format

Similarly to export – select resource type in drop down menu then push the button and in appeared window select needed folder and dxf-files in it (holding down Ctrl key for group of files selection) for their further import to PHOTOMOD Montage Desktop module.

For batch export of DEMs to CSV file, open the window similar to above described one, using menu command **Operations | DEM batch export to CSV**.
Fig.63 Batch export of DEM to CSV format file

In source data window you should select the project and DEMs folder in it. In the lower window select DEMs for export by double click and their names will be shown in Object list window. Then indicate the path to save export result and push OK. After export DEM.csv files are saved to the target folder and their number is the same as the number of initial resources.

You can also assign resulting data accuracy parameter for vectors batch export operations using command Operations | Export precision. This parameter allows to set up the number of decimal places for vectors vertices coordinates in resulting files of text formats (Generate, DXF, MIF/MID, WinGIS, ASCII, ASCII-A, LIG) for exporting from PHOTOMOD Montage Desktop, DTM, StereoDraw, StereoVectOr modules. After accuracy parameter input you should restart the appropriate module to activate the changes.

9.3.11 Operations with project on Aerial triangulation stage

If the project on Aerial triangulation stage is opened in PHOTOMOD Montage Desktop window (see the chapter 4.2 Aerial triangulation), you can start the following operations for it using commands of Operations menu item:

- **Automatic tie point measurement** – opens PHOTOMOD AAT module, where you can adjust and execute tie points measurement for images block, see the appropriate User Manual
- **Report on tie point measurement** – opens PHOTOMOD AAT module and the window of report on state of project relative orientation, see the appropriate User Manual
- **Tie points catalogue** – opens PHOTOMOD AAT module and the window containing catalogue of tie points measured on images block, see the appropriate User Manual
- **Block layout** – opens Block layout window, used for manual creation of images block layout, see detailed description in PHOTOMOD AAT User Manual.

9.4 TIN menu

Used for work with irregular model of relief – TIN (Triangulated Irregular Network), intended for creation of regular terrain model – DEM, and also for contour lines.
9.4.1 TIN creation in batch mode

If you are going to create TIN for all or several stereopairs of the project, which is on Block processing stage, you could use batch mode, see the chapter 9.3.10 Batch processing. Batch mode is intended for creating of adaptive terrain model for selected stereopairs using correlator, the same algorithm as for adaptive TIN building for one stereopair in PHOTOMOD DTM module (see the appropriate User manual).

To create TIN in batch mode select menu command TIN | Create in batch mode or push main menu icon to open the following dialogue:

The final TIN is triangulated from grid nodes by applying of modified Delaunay algorithm. There are the following parameters for adaptive TIN creation in batch mode:

- boundaries of model creation area – is set up in the Boundaries panel – for the entire stereopair or for existing pre-region. If there is no pre-region, TIN will be created for the entire stereopair or the stereopair will be skipped.
- rectangular grid step – is set up in the Compute pickets panel – the nodes of the grid are used for TIN nodes coordinates calculations using correlation algorithm. If Fixed nodes option is OFF (default mode) the program tries to compute the 3D coordinates of the most distinctive points (points with highest matching correlation) in the neighborhood of the grid node. The size of the point searching region is equal to 1/3 of the grid cell size. If the value of the third coordinate of the grid node cannot be defined the node is also rejected.
This window also allows to set up the type of the resulting TIN – global or separate for each stereopair by selecting the appropriate option in **Mode** field. It is recommended to create separate TIN for each stereopair if it is supposed to be edited by several operators.

Created terrain model could be saved as a set of pickets (by selecting the option **Save pickets**) or as a TIN (the option **Save TIN**), into resource with name input in the appropriate field.

In the names of target TIN and pickets, it is possible to use the following macro substitutions: % p - the project name, % m - the name of stereo pair, % d - the current date, % t - current time.

For example:

InfoMap_311 copy-R09_S86-R09_S85-06.05.2009-18:39:07-pickets
InfoMap_311 copy-R09_S86-R09_S85-06.05.2009-18:39:09-TIN

% p - InfoMap_311 copy
% m - R09_S86-R09_S85
% d - 06.05.2009
% t-18:39:09

Check the **TIN with convex hull** option to build a convex border in output TIN. If you would like to visualize steps of model creating in additional window, check the option **Show DTM status panel**.
Strips and Stereopairs panels and the select/deselect icons below them are used for selecting stereopairs for the transformation. Once the parameters are setup, push the Execute button to start the process or the Close button to cancel it.

9.4.2 Building block-wide TIN

PHOTOMOD Montage Desktop module as well as PHOTOMOD DTM is intended for building of block-wide terrain model (global TIN) by merging of “local” TINs, created for separate stereopairs. After merging the global TIN could be opened in PHOTOMOD DTM module for further editing. If you have pickets and breaklines for the whole block of images you can create a block-wide TIN by their direct triangulation. Select TIN | Create global command and at the Source data tab select the source resources with 3D points and lines used for the global TIN creation. Use Ctrl and Shift keys for group selection. Additionally to the resources with vector objects, TINs and pickets also can be used as a source data. So this method is applied either for merging TINs from different stereopairs just by the re-triangulation of all source points and linking all source lines and polygons as breaklines.

Besides, when you have global TIN built from pickets and breaklines, the breaklines are stored in the separate resource, even if the breaklines are built-in to the initial TINs. You can see it in the lower resources list on the Source data tab (see Fig.64).

Note: To link breaklines to the final TIN, add them to the Source data list

You could save the initial set of resources for TIN building into PHOTOMOD resource (using the Save button) and then you can load it next time for TIN building (the Load button).

On Parameters tab you can select additional options for TIN building:
- **Use breakline vertices as pickets** – for more reliable TIN building, when it is not required to edit breaklines on resulting TIN
- **Convex hull** – if the option is ON, resulting TIN border will be convex. It is useful when initial vector objects to be linked are not covering some part of the model (if any lakes or rivers are on large scale images for instance).
Fig. 65 Global TIN creation

Note that there is no guarantee that source triangle edges will be exactly the same as the output ones because the resulting TIN is building by re-triangulation of input points and breaklines. Though the resulting TIN contains linked breaklines they are editable separately (if the appropriate layer is active in the Layer manager, see the chapter 8.3 Layer manager).

Push the Build button after selection of TINs and parameters to start merging process. The output global TIN will be saved to the selected resource. The default “path” to the resource for the global TIN is Project name | Global TIN | resource name (entered by user in the Description field).

You can load the output global TIN to PHOTOMOD DTM module for editing – see an appropriate User Manual.

9.4.3 Open and save TIN

Menu command TIN | Open or the button in upper button bar opens TIN created using operation of global TIN creation (see the chapter 9.4.2 Building block-wide TIN), or in batch mode (see the chapter 9.4.1 TIN creation in batch mode), or in PHOTOMOD DTM module (see the appropriate User Manual). In the window opened select the name of PHOTOMOD resource, which contains TIN. The resource could be opened in “read only” mode if the corresponding option is on. To load several TIN’s to 2D window select objects in the list by mouse along with pressed Ctrl key.

When TIN is loaded in 2D window, corresponding layer with viewing settings appears in Layer manager (see the chapter 8.3 Layer manager).

Use the command TIN | Save to save the TIN after its creating or editing.

9.4.4 Export of TIN

- Export to Arc Generate
  Use a command TIN | Import / Export | Generate format | Export to export the source TIN to ArcINFO Generate format. The system opens a dialog of selecting output .gnp, .gml files. Click the Save button to export data. You can also select TIN elements to be exported using options Nodes, Edges, Triangles. As a result of export TIN nodes will be saved in .gnp files and edges and triangles – in .gml file. Another export parameter is Index (the default value is 0) that is used for linking of database tables.

- Export to DXF
  Use a command TIN | Import / Export | DXF format | Export to export the source TIN to AutoCAD DXF exchange format. The system opens a dialog of selecting output .dxf file. Click the Save button to export data. You can also select TIN elements to be exported using options Nodes, Edges, Triangles. Another export parameter is Layer code (the default value is 0) – code ID in AutoCAD system.

- Export to DGN
  Use a command TIN | Import / Export | DGN | Export to export the source TIN to DGN format of MicroStation system. The system opens a dialog of selecting output .dgn file and then you should select TIN elements to be exported, using options Nodes, Edges,
**Triangles.** Further DGN export parameters setting is the same as described in the chapter 9.5.3 *Export of vector objects.*

- **Export to ASCII**
  Use a command **TIN | Import / Export | ASCII format | Export** to export the source TIN to **ASCII** format (see the format description in **PHOTOMOD StereoDraw User Manual**). The system opens a dialog of selecting output .txt file. Click the **Save** button to export data. You can also select TIN elements to be exported, using options **Nodes, Edges, Triangles.** Another export parameter is **Index** (the default value is 0) that is used for linking database tables.

- **Export to ASCII-A**
  Use a command **TIN | Import / Export | ASCII-A format | Export** to export the source TIN to **ASCII-A** format (see the format description in **PHOTOMOD StereoDraw User Manual**). The system opens a dialog of selecting output .txt file. Click the **Save** button to export data. You can also select TIN elements to be exported, using options **Nodes, Edges, Triangles.** Another export parameter is **Index** (the default value is 0) that is used for linking database tables.
  You can also export selected TINs into each format using appropriate option.

### 9.4.5 Topology checking

In the process of creating and editing TIN, there may appear groups of vertices located too close to each other, which may lead to errors in further processing. **Check topology** command is used to detect and remove such groups of TIN vertices. This operation starts the process of searching for vertices close to each other. **Min. distance** and **Max. distance** in meters are the parameters of this operation. Couple of nodes is considered as erroneous if the distance between them is more than **Min. distance** parameter and less than **Max. distance**. Default values 0.0 and 0.3 meters accordingly. At that, either 2D or 3D distances could be measured (**Used metric**).

If the errors are found, TIN topology control operation opens erroneous points coordinates list. Selecting point in the list leads to locating marker in appropriate point on the screen. At that the erroneous points are visualized in “read only” mode. It is preferable to perform the operation in **PHOTOMOD DTM** module (see appropriate User manual) that allows you to correct errors immediately.

### 9.4.6 TIN checking

After global TIN creation it is recommended to check it using the main menu command **TIN | Check TIN**, to detect possible self-crossings of triangles edges (for example, created on the slopes angles near to minus). In case of such self-crossings the list of cross points and their coordinates appears.

Selecting the point in the list allows visualizing it in 2D/3D window; however, you can edit such points only in **PHOTOMOD DTM** module (see appropriate User Manual).

### 9.4.7 TIN’s comparison

If you need to compare some TIN (or pickets set) to another one, use the command **TIN | Compare TIN.** In the window opened select main and analyzed TIN and comparison parameters. The operation is similar to the operation of DEM accuracy control described in the chapter 9.7.3 **DEM accuracy control.**
Here you should input the following parameters:

In **Output** panel – number of TIN nodes to be saved in resulting file: **All points** or **Worst points** (number of worst values, indicated in the numeric field) – set of compared TIN nodes (or pickets), with maximal Z deviation.

Output text file could be in CSV or PHOTOMOD ASCII format (use the panel **Output format** to select it) and contains the following data for each node: number, coordinates X, Y, Z and Z deviation. At the end of file there are RMS, Average and maximal values.

Specify output file name and its path in **Output file** field.

Points located out of TIN, are not included to the statistics and are placed into separate file, with name indicated in field **Points placed out of TIN**.

After all parameters input push **OK** to start TIN’s comparing process.

### 9.4.8 Building TIN with objects

If there is DEM and also a set of objects as closed polygons, with heights over the ground surface (buildings roofs, for example), you can create terrain model, using these objects. The operation of terrain model creation is started by the command **TIN | Build TIN with objects**, which opens the window for selecting DEM and PHOTOMOD resource with polygons.
After selecting of initial resources and target name of resulting TIN, push OK to start model creating.

**9.4.9 TIN closing**

Use the command TIN | Close, to close current TIN layer, and the command TIN | Close all to close all TIN layers opened in 2D window.

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**9.5 Vectors menu**

**9.5.1 Open vector objects**

Vector objects are loaded to 2D window using menu command Vectors | Open or the icon in the upper button bar. In the window opened select the name of PHOTOMOD resource, which contains vectors. The resource could be opened in “read only” mode if the corresponding option is on. You can also select group of resources using pressed down Ctrl key to open them in 2D window.

When the resource is loaded in 2D window, the corresponding layer is added to the Layer manager and you can setup its displaying parameters (such as color for vectors). See the chapter 8.3 Layer manager.

**9.5.2 Import of vector objects**

- Import from Arc Generate
To import ArcINFO Generate file use the command Vectors | Import / Export | Arc Generate | Import and select Generate file in the opened window. Accessible file extensions are .gnp, .pnt for files with vector points and .gml, .lin for files with polylines.

Once the source file is selected, push OK to start import.

- **Import from DXF**

   Vectors | Import / Export | DXF | Import command is used to import AutoCAD .dxf file. Import parameters are as follows:
   - **Swap X, Y** – allows to switch between left-handed and right-handed coordinate systems using swap of X, Y coordinates of object vertices during import
   - **Use blocks as points** – allows to import origins of object’s blocks from AutoCAD as point objects
   - **Scale** – set a multiplier for all coordinate values (the default is 1.0).
   - **Origin** – allows to change the origin position (fields X, Y, Z), if necessary. The default value for all coordinates is 0.0.
   - **Import 2D objects** – marked option allows to convert 2D objects into 3D ones. At that the third dimension (objects vertices height – Z) is taken from the following sources:
     - **Constant elevation** – the same (user defined) Z value is assigned to all objects
     - **DEM from file** – Z coordinate is derived from a DEM in the following formats: PHOTOMOD DEM (.dem file), Surfer ASCII GRID (.grd file), ArcINFO ASCII GRID (.grd file)
     - **DEM from resources** – allows to acquire Z coordinates from selected PHOTOMOD resource
     - **Use for unknown elevations** – in case of using DEM for assigning Z coordinate for vector objects, NULL values (unknown elevations) are replaced by the entered value.
     - **Z from “Elevation” code** – Z-coordinate is imported from the Elevation attribute of DXF file

   *Note. Import from version R14 (AutoCAD 97, 98) is supported, import from older versions is not guaranteed*

Once the source file and parameters are selected, push OK to start import.

- **Import from DGN**

   To import DGN file from MicroStation system select the command Vectors | Import / Export | DGN | Import then select source file (with .dgn extension) and choose import parameters in next appeared window:
Fig.69 Parameters of vectors import from DGN file

**Coordinates conversion** panel allows to setup the coefficient which all vertices coordinate values are multiplied by during import (the default value is 1.0).

2D objects are converted into 3D during import. At that the third dimension (objects vertices height – Z) is taken from the following sources:

- **Constant elevation** – all the same (user defined) Z value is assigned to all objects
- **DEM from file** – Z coordinate is derived from a DEM in the following formats: PHOTOMOD DEM (.dem file), Surfer ASCII GRID (.grd file), ArcINFO ASCII GRID (.grd file)
- **DEM from resources** – allows to acquire Z coordinates from selected PHOTOMOD resource
- **Use for unknown elevations** – in case of using DEM for assigning Z coordinate for vector objects, NULL values (unknown elevations) are replaced by the entered value.

Once process parameters are selected, push **OK** to start import.

- **Import from ASCII**

**Vectors | Import / Export | ASCII | Import** command is used to import vector objects from ASCII file (with .txt extension). See the description of ASCII format in PHOTOMOD StereoDraw or DTM User Manual. ASCII format is used to store just vector graphics and ASCII A format also stores vector object attributes. Once the source file is selected, push **OK** to start import.

- **Import from ASCII-A**

**Vectors | Import / Export | Extended ASCII format | Import** command is used to import vector objects from ASCII A file (with .txt extension). See the description of ASCII A format in PHOTOMOD StereoDraw User Manual. ASCII A format is used to store both vector graphics and attributes. Once the source file is selected, push **OK** to start import.

- **Import from VEC**

**VEC** format (.vec extension) is a vector format of PHOTOMOD 3.11 version and earlier. To import .vec file, use the command **Vectors | Import / Export | Vec | Import**. Once the source .vec file is selected, push **OK** to start import process.
• **Import from LAS**

Laser scanning data represented as points is imported to **PHOTOMOD Montage Desktop** module as vectors layer. Use menu command **Vectors | Import / Export | LAS format | Import** to open the following window.

![Fig. 70 Parameters of import from LAS format](image)

In upper field of the window select LAS file for import and then setup the following import parameters:

- **Swap X and Y** – allows to switch between left-handed and right-handed coordinate systems using swap of X, Y coordinates of object vertices during import
- **Reflection** – allows to choose pickets layer (or all layers) from the list, which belongs to the same reflection level at laser scanning
- **Downsample** – turns on/off points filtering by grid with preset nodes step in meters. At that pickets heights are calculated as average from values covered by this grid cell.
- If the option **Convert coordinates** is on you can convert the initial coordinate system of the data into coordinate system of current PHOTOMOD project. Start selection of input coordinate system by pushing the button **Input CS**, and refer to the chapter 6.1 **Select coordinate system** for the further steps.

Once the source LAS file and import parameters is selected, push the **Import** button to start import process.

• **Import from CSV**

**Vectors | Import / Export | CSV | Import** command is used to import vector objects from CSV file (with .csv extension). In the window opened, specify CSV file for import (text format file with comma, space or some other symbol is used as coordinates separator).
9.5.3 Export of vector objects

Note. For vectors export operations you could setup export precision parameter in PHOTOMOD Montage Desktop module using the command Operations | Export precision, see the chapter 9.3.10 Batch processing.

- **Export to Arc Generate**

Use a command Vectors | Import / Export | Generate | Export to export currently loaded vectors to ArcINFO Generate format. The system opens a dialog of selecting output .gnp, .gnl files and the following export parameters:

- **Index** (0 - by default) is used for linking to database table.
- In **Target coordinate system** field you can turn on initial coordinate system converting into selected one, by marking the **Convert** option. Start selection of output coordinate system by pushing the button **CS selection**, and refer to the chapter 6.1 Selecting coordinate system.

Then start the export by pushing the **OK** button. Vector lines and polygons will be exported to .gnl file and vector points – to .gnp file with the same name.

- **Export to DXF**

Use a command Vectors | Import / Export | DXF | Export to export currently loaded vectors to AutoCAD DXF exchange format. The system opens a dialog of selecting output .dxf file and the following export parameters:

- **Layer code** (0 - by default) – is used for linking to database table.
• In **Target coordinate system** field you can turn on initial coordinate system converting into selected one, by marking the **Convert** option. Start selection of output coordinate system by pushing the button **CS selection**, and refer to the chapter 6.1 **Selecting coordinate system**.

Then start the export by pushing the **OK** button.

• **Export to DGN**

To export active vector layer to **DGN format** of **MicroStation** system select the command **Vectors | Import / Export | DGN | Export** then input new file name (with .dgn extension) and choose export parameters in next appeared window:

![DGN export parameters](image)

**Fig.72 Export to DGN format**

Parameters to be setup in **Linear units** panel (**Master units**, **Sub Units**, **MU / SU**, **SU / DGN Pos. Units**) are described below.

- **Origin** – allows to enter coordinates of the coordinate system origin (**X**, **Y**, **Z** fields). You can also use the **Auto selection** option for automatic calculation of coordinate’s origin.
- **Code** (0 - by default) – object code in **PHOTOMOD StereoDraw** module which will be assigned to the object after export from **PHOTOMOD Montage Desktop** and import to **PHOTOMOD StereoDraw**
- **Layer** (1 - by default) – layer number in **MicroStation** system, where vector objects will be loaded after export
- In **Target coordinate system** field you can turn on initial coordinate system converting into selected one, by marking the **Convert** option. Start selection of output coordinate system by pushing the button **CS selection**, and refer to the chapter 6.1 **Selecting coordinate system**.

**Format features:**
512 bytes of file space could be used for user information storing. Code, code name and object type is saved in this area and if the rest space is enough object attributes are also saved here.
Standard presentation of coordinates in DGN (at least, in the opened part of the format) is integer 32-byte. i.e. all saved coordinates may vary from 0 to 4*10^9 (or from –2*10^9 to 2*10^9), and without fractional parts. Since it is not easy to use coordinates in such form it was suggested the following. In addition to main units (position units in DGN terminology) there were also proposed subunits (SU) and master units (MU), and

\[
1 \text{ SU} = N \text{ Pos.units} \\
1 \text{ MU} = M \text{ SU},
\]

where \( N \) and \( M \) – arbitrary integers. You can assign arbitrary two-character names to MU and SU (but not to Pos. units). That allows to represent geodetic coordinates as a fractional numbers with fixed point (in PHOTOMOD system MU units are assigned to geodetic coordinates units). The range of changing of these coordinates is reduced correspondingly, i.e. in each exact case you should sacrifice either range or accuracy. In export dialogue you can set up both parameters \( N \) and \( M \). In the above mentioned example 1 MU=10^5 Pos. units, correspondingly the range of MU changing is approximately from –2*10^4 to 2*10^4, and that is not enough. That is why some new value Origin (point of origin) is set up. This value (with floating point) is added to the coordinates in MU. I.e. if \( \text{origin}=(X_0, Y_0, Z_0) \), the coordinates in DGN-file, may be located in parallelepiped with coordinates \((X_0 - 2*10^9 / M / N ; Y_0 - 2*10^9 / M / N ; Z_0 - 2*10^9 / M / N) - (X_0 + 2*10^9 / M / N ; Y_0 + 2*10^9 / M / N ; Z_0 + 2*10^9 / M / N) \).

PHOTOMOD export procedure allows user to assign origin manually or the system can define it automatically (if the option Auto selection is \text{ON} as a center of the parallelepiped circumscribed around all objects.

After parameters selecting, push the \text{OK} button to start export.

- **Export to ASCII**

Use a command \textit{Vectors | Import / Export | ASCII | Export} to export currently loaded vectors to ASCII format (see the description in PHOTOMOD StereoDraw User Manual). The system opens a dialog of selecting output .txt file and the following export parameters:

- \textit{Code} (the default value is 0) – object code in Code Table of PHOTOMOD StereoDraw module which will be assigned to the object after export from PHOTOMOD DTM and loading to PHOTOMOD StereoDraw.
- In \textit{Target coordinate system} field you can turn on initial coordinate system converting into selected one, by marking Convert option. Start selection of output coordinate system by pushing the button CS selection, and refer to the chapter 6.1 Selecting coordinate system.

After parameters selecting, push the \text{OK} button to start export.

- **Export to ASCII-A**

Use a command \textit{Vectors | Import / Export | Extended ASCII format | Export} to export currently loaded vectors to Extended ASCII format (see the description in PHOTOMOD StereoDraw User Manual). The system opens a dialog of selecting output .txt file and the following export parameters:

- \textit{Code} (0 - by default) – object code in Code Table of PHOTOMOD StereoDraw module which will be assigned to the object after export from PHOTOMOD DTM and import to PHOTOMOD StereoDraw
- \textit{Code name} (0 - by default) – object code name in Code Table of PHOTOMOD StereoDraw module which will be assigned to the object after export from PHOTOMOD DTM and import to PHOTOMOD StereoDraw
- \textit{Layer code} (0 - by default) – object layer code in Code Table of PHOTOMOD StereoDraw module which will be assigned to the object after export from PHOTOMOD DTM and import to PHOTOMOD StereoDraw
• In **Target coordinate system** field you can turn on initial coordinate system converting into selected one, by marking **Convert** option. Start selection of output coordinate system by pushing the button **CS selection**, and refer to the chapter 6.1 **Selecting coordinate system**.

After parameters selecting, push the **OK** button to start export.

You can also export only selected vectors into each format, using appropriate option.

### 9.5.4 Check topology

Spatial topologic relations between objects imply that their common borders or vertices coincide. In some cases there is not such coincidence, due to the operator’s fault – i.e. one vertex is digitized as two with close distance in between. Topology checking parameters for such duplicated vertices are as follows: **Min. distance** and **Max. distance** in meters. Couple of points is considered erroneous, if the distance between them is more than **Min. distance** parameter and less than **Max. distance**. Default values are 0.001 and 0.3 meters accordingly. At that, either 2D or 3D distances could be measured (**Used metric** option).

![Check topology](image)

**Fig.73**

If the errors are found, vector objects topology control operation (started using the command **Vectors | Check topology**) opens erroneous points coordinates list. Selecting point in the list puts the marker into appropriate point on the screen. You can also start the operation of vectors topology checking directly in **PHOTOMOD StereoDraw** and **DTM** modules (see appropriate User manuals). It is preferable because you can correct the errors immediately.

### 9.5.5 Vector objects saving

In order to save vector objects layer containing for instance, pre-regions for the entire images block, use menu command **Vectors | Save** which opens standard dialogue window for **PHOTOMOD** system resource saving.

### 9.5.6 Converting vectors into contours

Vector objects located in **Manager** active layer could be converted to contours, using menu command **Vectors | Convert to contours**. See also the chapter 9.6.6 **Converting contours into vectors**.

### 9.5.7 Create regular pickets by TIN

Menu command **Vectors | Create regular pickets by TIN** is used for creating pickets (point vector objects) by existing relief model – TIN. In the dialogue opened select project resource with TIN (on the **Source TINs** tab), and also parameters of the process on the **Parameters** tab.
Fig. 74 Parameters of creating pickets by TIN

You can re-define the extents of output pickets set, by changing coordinate values in North, West, South, East text fields. The defaults are the coordinates of the corners of the rectangle, which defines an area of the source TIN. Use the Cell size parameter to specify a distance between pickets in meters. Please remember, that too small Cell size just causes increasing of the output file size without improving the accuracy.

9.5.8 Vector objects closing

Use the command Vectors | Close, to close current vector's layer and the command Vectors | Close all to close all vector's layers opened in 2D window.

9.6 Contours menu

9.6.1 Open contours

Menu command Contours | Open or the button in upper button bar opens contour lines resource. In the window opened select the name of PHOTOMOD resource, which contains contours. The resource could be opened in “read only” mode if the corresponding option is on. To load several resources to 2D window, select them using pressed down Ctrl key.

When contours resource is loaded to 2D window, the corresponding layer is added to the Layer manager and you can setup its displaying parameters (see the chapter 8.3 Layer manager).

9.6.2 Merging contour lines

Contours could be merged using the window opened by menu command (Contours | Contours merge). Select there initial contour lines on Source contours tab and merge
them as described above. Please note, that this method requires careful preparation the contours for merging.

The parameters of the merging process are:

- **Maximum distance** – end vertices of a pair of contour lines located at a distance less than this value will be merged
- **Verification distance** – this value should be greater than Maximum distance. In case if the system has found “breaks” between contour lines less than this value (and greater than Maximum distance) it opens a list of such vertices. Selecting a line in the list causes marker moving to the corresponding position on the image.

After parameters selection push **Save** to start merging process. The output global contours will be saved to the selected resource. The default “path” to the resource for the global contours is **Project name | Global contours | resource name** (entered by user in the **Description** field).

Actually you can merge contours by just creating global TIN or DEM for the block of images (see the chapters 9.4.2 **Building block-wide TIN** and 9.7.2 **Building DEM**), load it to **PHOTOMOD DTM** and build contour lines. Besides, you can load contour lines from adjacent stereopairs and merge them manually using editing tools in **PHOTOMOD DTM**.

### 9.6.3 Merge verifying

You can check the quality of contours merging using the command **Contours | Merge verifying**. This operation is searching for breaks between merged contours. The only process parameter is **Verification distance**. In case if the system has found “breaks” between contour lines, that are less than this value, it opens a list of such vertices. Selecting a line in the list causes marker moving to the corresponding position on the image for editing contour lines.

In fact it is better to verify the merging in **PHOTOMOD DTM** module, since in this case you can fix errors in contour lines immediately.

### 9.6.4 Building contours from DEM

It is possible to build contour lines using DEM if DEM is opened in 2D window and its layer is active in **Manager**. Select the command **Contours | Build from DEM** to open window with the following parameters:
Fig.75 Parameters of contour lines building

In DEM panel:
The Min. elevation and Max. elevation fields show the appropriate values of DEM, that allows to estimate heights range for contours creation and to input Starting level and Step of contours (see below).

You can turn on smoothing of the initial DEM if necessary prior to contours building by marking the option Smooth.

Algorithm of DEM smoothing prior to contours building uses method of “smoothing window”, which moves from node to node of DEM and considers heights and weights of the adjacent nodes. Smooth level parameter shows the level of smoothing of DEM’s noises and spikes, and can vary from 0 (no smoothing) to 1 (maximal smoothing). The average smoothing level is set by default. This parameter specifies the weights of DEM's nodes, fallen within the “smoothing window” that will be considered at calculation of smoothed height value of the central node of the “window”.

The “smoothing window” is a square with side, expressed as a number of DEM’s nodes that is shown in Aperture size field (default value is 3x3 nodes). Aperture size change results in change of smoothing level of the whole DEM.

In Contours panel:
- Starting level – minimum Z value of contour (in meters)
- Step – contours interval in meters
- Minimal nodes number – used to delete small contour lines (with a number of nodes less than the selected value – the default is 5)

Turn the option Thick contours on to create thick contours according to the settings of this panel: starting level and the interval of thick contours (5 – by default).
Additionally you can setup here contours filtering parameters by RMS noise threshold (see PHOTOMOD DTM User Manual) and contours smoothing parameters by curvature threshold. It is recommended to control contour lines intersections after their smoothing (see the chapter 9.6.5 Contour lines intersections control).

Created contour lines are saved to the selected resource and can be loaded to PHOTOMOD DTM for editing (see appropriate User Manual).

9.6.5 Contour lines intersections control

After contours smoothing they could be intersected or self-intersected. Menu command Contours | Intersections control opens list of intersections coordinates. Selecting intersection point in the list places a marker in this point in 2D window.

It is recommended to control intersections in PHOTOMOD DTM module (see appropriate User Manual) since in this case you can fix errors in contour lines immediately.

9.6.6 Converting contours into vectors

Contour lines located in active layer of Manager could be converted into vector objects, using the command Contours | Convert to vectors. The window appeared allows to setup the parameters of this process as described in the chapter 9.6.10 Export of contours). After such transformation contours turn to vectors with editable vertices. See also the chapter 9.5.6 Converting vectors into contours.

9.6.7 Build from TIN

The operation of TIN building could be performed if TIN is opened in Layer manager and on the screen either. Menu command Contours | Build from TIN opens a dialogue (Fig.76) with following parameters:

- **Starting level** – minimal height value in meters
- **Interval** – contours interval in meters
- **Minimal number of vertices** – used to delete small contour lines (with a number of vertices less than the selected value – the default is 5)

If the option Thick contours is ON, input thick contours starting level and quantity of usual contours between thick ones (default value – 5).

![Fig.76](image-url)
9.6.8 Save

You can save Contour lines layer using menu command **Contours | Save** if the layer is active in **Layer manager**.

9.6.9 Import of contours

Contour lines may be imported from formats, described in the chapter 9.5.2 **Import of vector objects**. Note that only polygons and polylines could be imported.

9.6.10 Export of contours

Use menu command **Contours | Import / Export** to export of current layer of contour lines. Contour lines export formats are the same as for vector objects described in the chapter 9.5.3 **Export of vector objects**.

![Fig.77 Settings of contours export to DXF format](image)

The window opened used to setup the following export parameters.

In **Code** panel you can assign codes to contours using appropriate fields, that allow to visualize them correctly after export.

The **Target coordinate system** panel is intended for transferring contours into another coordinate system after export. Push the **CS selection** button to open a window for new coordinate system selection, see about further procedures in the chapter 6.1 **Selecting coordinate system**.

You can setup a width of thin contours during their export to DXF or DGN formats using the **Thinning** slider (default value is 4). This width is shown in corresponding software systems after contours export. At that thin contours are exported into separate layer.

Use the **Parameters** button to define specific contour lines exporting parameters (see below). Since contour lines in most cases are represented as Bezier curves, the source smooth lines are approximated by a set of additional vertices for export as a polyline. To setup this approximation, mark **Interpolation** option and specify the following parameters.

- **Step** – distance between vertices which approximate the source curve
• **Precision** – allows to add more vertices in some fragments of the polyline. If the distance between the source smooth curve and output polyline is greater than the **Precision** value specified, there will be more vertices added to a polyline unless the criterion is satisfied. Click the **Apply** button to preview contour lines in **Contours** window after selecting parameters.

![Contours window](image)

**Fig.78**

Other **Contours** window elements are as follows:
• **Show vertices** – allows to display vertices of contour lines
• **No smoothing** – used to export contours without approximation of smoothing
  - 1 step zoom in (hot key “*”)
  - 1 step zoom out (hot key “/”)
  - fit image to window (hot keys “Alt-Enter”)
  - 1:1 zoom (image cell corresponds to screen pixel) (hot keys “Alt-1”)
• **Thinning** – allows to select contours color
• **Thinning** – allows to select background color

You can also reduce number of displaying contour lines (perform image sampling) using the slider **Thinning**, that allows to speed up the window redrawing. See also **PHOTOMOD DTM User Manual**.

When all needed parameters are setup, push **OK** to close the **Contours** window with saved settings or push **Cancel** to close the window and cancel settings.
9.6.11 Check topology of contour lines

The operation of contour lines topology checking (menu command Contours | Check topology) is similar to the same operation for the vectors – see the chapter 9.5.4 Check topology.

9.6.12 Contours interpolating and smoothing

Contours opened in active layer in 2D window can be smoothed, i.e. sharp angles at lines vertices will be smoothed using Bezier algorithm. Smoothing operation is starting by menu command Contours | Interpolate and smooth, and is applied to all contour lines in active layer or just to selected ones, depending on option chosen in parameters window.

![Fig.78 Parameters of contours smoothing](image)

In this window you can adjust smoothing level (in %) using the appropriate slider.

9.6.13 Contours closing

Use the command Contours | Close to close current contour’s layer and the command Contours | Close all to close all contours layers opened in 2D window.

9.7 DEM menu

9.7.1 DEM open and save

Menu command DEM | Open or the button in upper button bar used to open DEM (digital elevation model) in 2D window. In the window opened you should select the name of
PHOTOMOD resource, which contains DEM. The resource could be opened in “read only” mode if the corresponding option is on. To load several resources to 2D window select them in the list by mouse along with pressed Ctrl key.

When DEM resource is loaded, the corresponding layer is added to the Layer manager and you can setup its displaying parameters (see the chapter 8.3 Layer manager).

Use the command DEM | Save to save TIN after its creating or editing.

9.7.2 Building DEM

There are several ways of regular grid (DEM – Digital Elevation Model) creation, depending on the source objects: irregular network of triangles (TIN – Triangulated Irregular Network), pickets and contour lines.

All of the ways are described below.

Note: Building DEM larger than 4 GB is impossible.

9.7.2.1 From TIN

The command DEM | Build | From TIN opens a dialog of the source TIN (or TINs) and parameters selection (Source TIN and Parameters tabs respectively).

You can re-define the extents of output DEM by changing coordinate values in North, West, South, East text fields. Coordinates of the corners of the rectangle, which describes an area of the source TIN are used by default.

Use Cell size parameter to set a size of DEM cell (distance between its nodes) in meters. This value should not be much less than the size of the smallest TIN triangle (see PHOTOMOD DTM User Manual). Too small DEM cell size just causes increasing of the
output file size without improving the accuracy. Use the option **Start DEM accuracy control after building** to calculate Z-residuals between the source TIN nodes and output DEM cells (see the chapter 9.7.3 **DEM accuracy control**). At that you can assign maximal number of TIN vertices where such Z difference will be calculated (in window opened by the **Parameters** button).

**Split into sheets** option is used for splitting DEM into sheets in the process of building it from the TIN. If **Split into sheets** checks box set, then the **Split parameters** window is opened for setting the sheets parameters.

To change the dimensions of the output DEM, enter new coordinates in the West, South fields. Specify the sheets sizes in the Width and Height fields in meters (on the ground). In the Number of sheets / Horizontally, Number of sheets / Vertically fields the resulting number of sheets is displayed.

In the Base name field is given by «root» sheet name (Sheet by default).

Calculate parameters using existing DEM button makes it possible to choose limits and step during for creating DEM in such a way that its nodes coincide with nodes of another DEM in the overlap area. This is necessary for correct creation of orthophoto when using multiple DEMs.
Fig. 80 Digital Elevation Model

When marker moves over the DEM created, you can see DEM nodes plane and height coordinates in Status line at the bottom of 2D window.

Use double click on the icon leftward from DEM layer name in Manager window, to open an additional dialogue window that allows to adjust DEM transparency in 2D window using an appropriate slider. This option is available if Open GL graphic mode is ON in Montage Desktop module settings on Visualization tab (see the chapter 9.9 Service menu).

9.7.2.2 From pickets

The command DEM | Build | From pickets opens a dialog for selection of picket resources on the Source pickets tab, similar to window of initial TIN’s selection, see the chapter 9.7.2.1 From TIN.

After pickets selecting use the Parameters tab to setup the parameters of DEM building algorithm.

Algorithm of DEM building from pickets uses method of “smoothing window”, which moves from node to node of DEM over set of pickets and considers heights and weights of the pickets fallen in it. The height of DEM node located in the center of the “window” is defined as total of picket’s heights in the “window” according to their weight.

Push the Parameters button to adjust parameters of smoothing algorithm.
Fig.81 Parameters of DEM creation from pickets

**Search distance** parameter defines radius of the “smoothing window” (in meters on terrain). Make sure that **Cell size** of the DEM created (see its description in the chapter 9.7.2.1 From TIN) is less than the diameter of the “smoothing window”.

The distance from the picket to the DEM cell center may be raised to the power to consider its weight during calculation of height of DEM’s center in the “smoothing window”. You can select the power (1, 2 or 3) in the **Inverse distance power** field.

9.7.2.3 From contours

The command **DEM | Build | From contours** opens a dialog for selection of contours resources, similar to window of initial TIN’s selection, see the chapter 9.7.2.1 From TIN.

When source contours are selected, use the **Parameters** tab to setup the parameters of DEM building.

Algorithm of DEM building and its parameters are similar to those described in the chapter 9.7.2.2 From pickets.

9.7.2.4 From regular pickets

If there is a pickets set created in nodes of regular grid in PHOTOMOD DTM module (see the appropriate User Manual), you can use them for DEM building. Start the operation using menu command **DEM | Build | From regular pickets**.
In the window opened select regular pickets’ resource on the Source pickets tab, and parameters of DEM building algorithm on the Parameters tab.

Algorithm of DEM building from pickets uses method of “smoothing window”, which moves from node to node of DEM over set of pickets and considers heights and weights of the pickets fallen in it. The height of DEM node located in the center of the “window” is defined as total of picket's heights in the “window” according to their weight.

Push the Parameters button to adjust parameters of smoothing algorithm. Search distance parameter defines radius of the “smoothing window” (in meters on terrain). Make sure that Cell size of the DEM created (see its description in the chapter 9.7.2.1 From TIN) is less than the diameter of the “smoothing window”.

If you want to close the pickets’ layer in 2D window after DEM building, select an appropriate option and push OK.

The resulting DEM is saved to the selected resource and DEM layer is created in Manager (see the chapter 8.3 Layer manager).

9.7.3 DEM accuracy control

After DEM creation you can perform its accuracy control operation. It “compares” the output DEM and the source TIN (see the chapter 9.7.2.1 From TIN), and is started using menu command DEM | Accuracy control. The program calculates a difference in Z coordinate between each TIN node and the corresponding DEM cell and opens a list of points which have the highest difference values.
Selection of a line in the list places the marker to corresponding position of the image in 2D window to allows you to view and edit the TIN. While editing you can delete selected TIN node (using the button or Del key) or delete all nodes, where the error is more than on selected node (using the button ). Thus, DEM accuracy control operation is one of the tools for detecting of erroneous TIN nodes (peaks).

Once insufficient vertices are deleted from the list, you can re-build the DEM immediately by pushing the button .

Besides, you can save the results of DEM accuracy control to the text file using the button in this window.

9.7.4 DEM’s merging

Another way of creating DEM is merging of several initial DEM’s into “global” one. Use menu command DEM | Merge DEM’s to start DEM’s merging. The command opens the dialogue for initial DEM’s selection from available resources of current or other projects and parameters specifying (tabs Source DEM’s and Parameters respectively).
Fig. 84 Global DEM building

Select initial resources of the project (or contained in other projects available in the list) containing DEM's for merging on the first tab (for group selection use Ctrl or Shift keys along with mouse click). After that push the button \( \rightarrow \) (Add selected) or \( \gg \) (Add all) to place selected items into Source DEM's panel.

Then go to the Parameters tab to adjust the following parameters of global DEM building.

Fig. 85 Global DEM building parameters
You can re-define the extents of output DEM by changing coordinate values in *North*, *West*, *South*, *East* text fields. Coordinates of the corners of the rectangle, which borders an area of the source TIN are used by default.

Use *Cell size* parameter to set a size of DEM cell (distance between its nodes) in meters. Too small DEM cell size just causes increasing of the output file size without improving the accuracy.

Merging parameters are similar to those described in the chapter 9.7.2 *Building DEM*. The additional parameter of merging (shown in the window opened by the *Parameter* button) is elevation in overlapping area: choose upper DEM, lower DEM or average elevation in the opened panel (Fig.86).

![Fig.86 DEM’s merging parameters](image)

After initial DEM’s and parameters selection, push **OK** to start global DEM building.

*Note: Building DEM larger than 4 GB is impossible.*

### 9.7.5 DEM to pickets conversion

DEM opened in 2D window could be converted into pickets set using menu command *DEM | Convert to pickets*. In the dialog appeared you should specify the conversion parameter *Sampling*, to setup simplification degree during pixels to pickets conversion. For example, if it is 1 there is no DEM sampling, and when it is 5 height values are taken from DEM cell with size 5x5 pixels.

After conversion DEM elements become pickets in vector objects layer in 2D window.

### 9.7.6 Import of DEM

Menu command *DEM | Import/Export* is used to import DEM from the following external formats:

- **Surfer ASCII grid** – file with .grd extension
- **ArcINFO ASCII grid** – file with .grd extension
- **GeoTIFF DEM** – file with .tif extension
- **USGS DEM** – file with .dem extension
- **BCGIS DEM** – special file with .dem extension, importing parameter is DEM format in bytes per pixel
- **VectOr MTW** – file with .mtw extension
- **ASCII format** – file with .txt extension
- **CSV format** – file with .csv extension, where comma or space are used as a delimiter
- **DTED DEM format** – file with .dt2 extension
- **ERDAS Imagine DEM format** – file with .img extension (from ERDAS system)
- **PCIDSK DEM format** – file with .pix extension (from PCI Geomatics system)
- **PHOTOMOD 3.1 DEM format** – file with .dem extension (from earlier versions of PHOTOMOD system)
- **PHOTOMOD DEM** – file with .dem extension

Select a file of the type you need and click the **Open** button to start import. PHOTOMOD Montage Desktop opens a window for output DEM resource selection. Once import process is finished the DEM is added to the list of layers in the **Layer manager** (see the chapter 8.3 **Layer manager**) and displayed in 2D window.

### 9.7.7 Export of DEM

Menu command **DEM | Import/Export** is used to export DEM to the following external formats:

- **Surfer ASCII grid** – file with .grd extension
- **ArclINFO ASCII grid** – file with .grd extension
- **GeoTIFF DEM** – file with .tif extension
- **USGS DEM** – file with .dem extension
- **ASCII** – file with .txt extension
- **CSV** – text file with .csv extension with space or comma as delimiter
- **DTED DEM format** – file with .dt2 extension. Files containing DEM in WGS 84 coordinate system are created during export to this format. The DEM is split into sheets which have fixed size – 1 degree in latitude and longitude. Therefore the output DEM may consist of several sheets, and you can see their border coordinates in the **North**, **East**, **South**, **West** fields of the window of export parameters.
- **ERDAS Imagine DEM format** – file with .img extension (to ERDAS system)
- **PCIDSK DEM format** – file with .pix extension (to PCI Geomatics system)
- **VectOr MTW** – file with .mtw extension

When exporting DEM to **VectOr** format besides the output .mtw file you have to select a **map** (file with .sit extension) you want your DEM to be added to. In case of a new map creation you get an additional dialog (Fig.87) with the following fields to be filled out:

- **SIT scale** (scale factor of the map to be created)
- **Work area name** (arbitrary name of geographic region)
- **Resource file name** (a “classifier” file with a library of map symbols). Several standard files-classifiers for different map scales are included to PHOTOMOD installation kit and are stored in **PHOTOMOD \ Vector** folder.

![New SIT dialog](image)

**Fig.87 Export DEM to PHOTOMOD VectOr**

See also **PHOTOMOD VectOr** User Manual.

Select type and name of the output file and push the **Save** button to start the export.
9.7.8 DEM verifying by triangulation points

The operation (started by the command **DEM | Verify by triangulation points**) is used for DEM quality verification by comparison of heights between current DEM and triangulation points. Z-deviation in meters is calculating for each triangulation point of current DEM.

The results of the verification are shown in the following table:

<table>
<thead>
<tr>
<th>N</th>
<th>Name</th>
<th>Type</th>
<th>Use</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>Ez</th>
</tr>
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<td>✔</td>
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<tr>
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</tbody>
</table>

**Fig.88 DEM verifying by triangulation points**

This window shows Z residuals (**Ez** values) between each point of DEM and triangulation points, as well as RMS error for all points and maximum Z residual. You can exclude triangulation point from RMS and Maximum calculations by clearing of check box in **Use** column. Note that if the control point is located on the roof of building or somewhere else over the ground, the corresponding error includes this Z displacement.

Select a point in the list and estimate its position on the image – marker in 2D window will move to selected point's position.

Point's list shown in the table could be sorted by name, type, Z coordinate, and also by Z deviation (**Ez**), using mouse click on the appropriate column header.

Turn off the option **In use only** to hide points, which are out of current DEM area (points with red signs in **Use** column).

The button **Create report** in left lower corner of the window opens a window containing the report on DEM accuracy control.
9.7.9 NULL cells searching

Menu command DEM | Search NULL cells starts searching for the pixels with unknown heights in the current DEM, that is used as an additional control of DEM creation.

9.7.10 DEM splitting into sheets

DEM created for the entire images block could be split into separate sheets. If DEM is opened in 2D window and active in Manager window, you can split it into sheets using menu command DEM | Splitting into sheets. The window opened is intended for splitting parameters selecting:
**Fig. 90 Splitting parameters for DEM sheets**

**Sheets block extents** panel is used to show and edit DEM frame coordinates in user’s units.

Then you can assign sheet’s size in **Width** and **Height** fields. After that sheets number will be recalculated automatically and shown in the **Number of sheets** panel.

In bottom field of the window you can assign the name of sheets resource. Resulting DEM sheets are saved into PHOTOMOD resources and stored in the current project folder in DEMs subfolder. Use PHOTOMOD Explorer utility or project resources window (menu commands **Service | PHOTOMOD Explorer** or **Service | Project resources** accordingly) to view the list of sheets.

### 9.7.11 DEM closing

Use the command **DEM | Close** to close current DEM layer, and the command **DEM | Close all** to close all DEM layers opened in 2D window.

### 9.8 Pre-regions menu

**Pre-regions** are arbitrary 2D vector polygons “drawn” over the block of images in PHOTOMOD Montage Desktop. You can use pre-regions for example to define areas of TIN creation for each stereopair taking into account overlapping areas between strips and images in the strip.

**Note. If PHOTOMOD system is opened without project (see the chapter 4.5 Start PHOTOMOD Montage Desktop without project) pre-regions in Montage Desktop module are not created and Pre-regions layer in Manager window is not exist**

### 9.8.1 Automatic pre-regions creation

Automatic procedure of pre-regions creation (is started by menu command **Pre-regions | Autobuilding**) creates pre-regions for each stereopair (approximately in the middle area depending on the images and strips overlapping). The command opens a window for setting up the following parameters of the process:

**Build pre-regions for strips** – allows to build pre-regions for all strips of the block or for selected ones depending on the option selected.
Use group selection mode (mouse drag along with pressed Shift key) to select several strips in 2D window. At that all strips which borders are included into selection frame will be selected and you can start pre-regions auto-building just for them. Press Esc key to cancel strips selection.

If it is necessary to delete previous pre-regions, select the option Remove existing pre-regions. If this option is off, new pre-regions will be added to existing ones. Automatic pre-regions building allows to remove tiny narrow polygons created. Use the Remove slivers slider to set minimal width of pre-regions, and all polygons with less width will be removed.

After pushing the Execute button auto pre-regions with spatially coincided boundaries are built considering overlapping between images and strips. Automatic pre-region’s polygons may have some holes and overlaps in cases of non-standard block configuration – when images are significantly rotated or overlap percentage is changed along the block. That is why after creating pre-regions for complicated images block the pre-regions should be verified and edited both manually or automatically, see the chapter 9.8.4 Pre-regions editing.

Automatic pre-regions building process opens three layers in 2D window Manager: Pre-regions errors, Pre-regions outer boundary and Pre-regions inner boundary.

You can delete unnecessary pre-regions in the following way: create the external pre-region border, by drawing vector polygon contouring all images of the whole block or its part in Pre-regions outer boundary layer. Then select outer boundary in 2D window and cut off the pre-regions by this boundary, using menu command Pre-regions | Pre-regions boundary. In the window opened select the option to cut off the pre-regions: using all boundaries or just selected ones.
In case of complicated shape of images block – with non-standard overlap areas between images and strips and big enough relative images turn, the automatic pre-regions should be visually checked and edited if needed. Besides you can check it automatically using menu command **Pre-regions | Verification**, which opens the window with the following criteria:

**Mark zones lying inside the pre-region area and belonging to none of the pre-regions**
**Mark zones lying near the border of the pre-region area and belonging to none of the pre-regions**
**Mark zones belonging to more than one pre-region**
**Mark pre-regions not assigned to a model**
**Mark pre-regions extending beyond the models boundary**
**Mark pre-regions with a width less than ___% of its length**
**Mark pre-regions with an area less than ___% of the model area**

Take the boundary into account – if there is the outer boundary of pre-regions you may check it considering this boundary, if the option is on.

After the verification the erroneous pre-regions are appeared in the **Pre-regions errors** layer and are highlighted by color in 2D window (Fig.92). Click on erroneous pre-regions to show the error type in Status panel in the bottom of 2D window.

You can correct selected erroneous pre-regions automatically using the command **Pre-regions | Correction**. In the window opened (Fig.92) select correction parameters needed:

**Adjoin zones belonging to none of the pre-regions** – small polygons, which do not belong to any pre-region, will be attached to the closest one

**Adjoin pre-regions with small area to the neighbors** – small polygons will be attached to the adjacent ones with bigger area

**Cut off pre-regions extending beyond the models boundary** – if the pre-region is out of stereopair boundary its unnecessary part will be clipped.

![Fig.92 Highlighted errors of pre-regions building and their correction options](image)
You can verify and correct pre-regions both all of them on the block and those selected in 2D window. Make sure that Pre-regions layer is active in Manager and in parameters window the Selected option is marked.

9.8.2 Loading pre-regions

To open pre-regions in 2D window use the command Pre-regions | Load.

9.8.3 Saving pre-regions

To save pre-regions use the command Pre-regions | Save. As a result the pre-regions will be saved to the appropriate resource. Every project has only one resource with pre-regions.

9.8.4 Pre-regions editing

To edit or create pre-regions select Pre-regions layer in the Layers manager (see the chapter 8.3 Layer manager).

To draw a polygon (or its inner or outer border) use one of the following commands:

- add vertex – Insert key or menu command Pre-regions | Edit | Add point
- create polygon – Enter key

To edit pre-region use one of the following commands:

- select vertex – single mouse click
- move selected vertex – Ctrl key + mouse moving
- delete selected vertex – Delete key or menu command Pre-regions | Edit | Delete point
- select polygon – double mouse click
- delete polygon – Delete key or menu command Pre-regions | Edit | Delete polygon

If you have both polygon and vertex selected, the first pressing of Delete key deletes vertex and the second one deletes polygon.

- delete pre-regions (all polygons) – Pre-regions | Edit | Clear pre-regions

You can also draw a pre-region manually along the border of the adjacent pre-region using snapping mode activated by V hot key. If the snapping mode is on you can add vertices of a new pre-region only to vertices of existing pre-regions.

Besides, you may use the following operations for creating and editing of pre-regions polygons, as well as its inner or outer borders:

- Draw orthogonal line by mouse along with A key pressed
- Select polygons and vertices using menu buttons, see the description of selection modes in the chapter 9.10 Windows menu
- Select vertex closest to the marker (Shift-S hot keys)
- Move selected vertex into marker position (J hot key)
- Move marker into selected vertex position (~ hot key)
- Join to polyline in vertex (Shift-V hot keys)
- Join to polyline in arbitrary point (Shift-L hot keys)
- Auto-continuing along polyline – see the details about this operation in PHOTOMOD DTM or PHOTOMOD StereoDraw User Manuals.

9.8.5 Import of pre-regions

Pre-regions can be imported from formats, described in the chapter 9.5.2 Import of vector objects. Note that only polygons will be imported.
9.8.6 Export of pre-regions

Pre-regions can be exported to formats, described in the chapter 9.5.3 Export of vector objects.

9.8.7 Check topology

The operation of pre-regions topology verification (started by menu command Pre-regions | Check topology) is similar to the same operation for the vectors – see the chapter 9.5.4 Check topology.

9.9 Edit menu

The Edit menu is available for projects on processing stage. Contains the following tools of vector objects selection and editing:

- **Undo** – cancels the last operation performed (see the chapter 9.9.2 Undo and Redo operations). Duplicated by the button of the toolbar or by the Alt-BS shortcut.
- **Redo** – repeats last cancelled operation (see the chapter 9.9.2 Undo and Redo operations). Duplicated by the button of the toolbar or by the Alt-Shift-BS shortcut.
- **Undo log** – opens a log containing a list of edit operations performed in current session, that allows to select and undo/redo them (see the chapter 9.9.2 Undo and Redo operations). Duplicated by the button of the toolbar or by the Alt-H shortcut.
- **Selection** – opens an additional menu containing a set of selection tools and modes for vector objects editing. See the chapter 9.11 Windows menu.
- **Measure mode** – turns on/off measurements over a model mode (see the chapter 8.4 Measurements over the model). Duplicated by the button of the toolbar.
- **Fix marker by Z** – turns on/off marker moving in plane (with fixed Z coordinate). See the chapter 8.1.5.4 Fixed Z mode.
- **Swap X <-> Y** - swaps X and Y coordinates for all vertices of active layer.
- **Convert to another CS..** - converts coordinates of all vertices of active layer to another coordinate system by menu command Edit | Convert to another CS.. A dialog appears allowing the selection of input and output coordinate systems (Source coordinate system and Target coordinate system panels correspondingly). It's also possible to start GeoCalculator from this dialog (see corresponding User's Manual).

Note: by default while working with project its coordinate system is chosen as input and output. While working without project it's required to choose both.

- **Move all vertices..** - Moving all vertices of active layer to 3D-vector specified is performed by menu command Edit | Move all vertices... - it opens a window Move all vertices of the layer, which can be used to set coordinates of new 3D-vector (Displacement vector).
9.9.1 Objects editing

Selection and editing of vector objects in PHOTOMOD Montage Desktop is provided in the same way as in PHOTOMOD DTM or PHOTOMOD StereoDraw modules, see the appropriate User Manual.

9.9.2 Undo and Redo operations

To cancel last editing operation use the button (Undo) or Alt-BS hot keys, to repeat last cancelled operation – the button (Redo) or Alt-Shift-BS hot keys. You can also cancel several operations by using Undo log (opened by clicking the button or Alt-H hot keys).

Use mouse and standard MS Windows group selection tools (Shift and Ctrl hot keys) to select operations in the Performed actions panel. To undo selected operations push the Undo selected button. To redo cancelled operations select those in the Cancelled actions panel and push the Redo selected button.
The **Undo** and **Redo** buttons are used to cancel and repeat the last operation. The **Clear undo log** button clears the message list so that redo and undo operations become impossible.

**Note. When working with a big number of vector objects UNDO operation may slow down the editing process. You can turn off the UNDO using menu item Service | Preferences | System | UNDO (see the chapter 10 PHOTOMOD Montage Desktop settings)**

### 9.10 Service menu

**Service** menu item contains the following commands:

- **GPS** – submenu with commands implementing GPS receivers support, see chapter 15 GPS support
- **Docking** – docks icon panels that may be moved by user
- **Toolbar** – opens / hides the main icon panel
- **Save image** – allows to save image shown in a 2D window to TIFF file, see the chapter 8.1 2D window
- **Data restore** – opens list of project resources available for restoring
- **PHOTOMOD Explorer** (duplicated by Ctrl-E hot keys) – starts **PHOTOMOD Explorer** for working with PHOTOMOD resources (see PHOTOMOD Overview)
- **Project resources** – opens **PHOTOMOD Explorer** to view the resources of current project
- **Control Panel** – opens **PHOTOMOD Control Panel** window used mainly for PHOTOMOD storages setting up (See PHOTOMOD Overview)
- **Load georeferenced image** – allows to open a raster image, referenced to coordinate system, in 2D window
- **Show in Google Maps** – opens Google Maps web site (maps.google.com) in web browser window with image of current PHOTOMOD project territory. Coordinates of the image center are geodetic coordinates of cursor in 2D window of **PHOTOMOD Montage Desktop** module. The operation is available for projects referenced to geodetic coordinate system (in WGS 84) and that are on Block processing stage (see the chapter 4.4 Block processing)
- **Raster georeferencing** – opens window used for raster map georeferencing, see the chapter 8.7 Raster map window
- **View as an array of images** – turns on/off project images block preview in 2D window as a set of images without georeferencing, that allows to rearrange both images and strips (see also the chapter 4.1 Block forming)
- **Display contours as smooth curves** – turns on/off contour lines displaying as Bezier curves
- **Settings** – opens system preferences panel, see the chapter 10 PHOTOMOD Montage Desktop settings
- **Mouse setup** – opens a window for mouse buttons and foot pedals programming to use them instead of keyboard keys. Basically this is used for time-consuming operations such as 3D feature extraction or TIN editing in modules intended for stereo processing (**DTM** and **StereoDraw**). Nevertheless you can setup mouse or foot pedals in **PHOTOMOD Montage Desktop** module, see **PHOTOMOD Overview** User Manual for the details about mouse configuration and special devices usage.

### 9.11 Windows menu

**Windows** menu is used to manage windows and toolbars on the screen and includes the following options:
• **Toolbars** – shows / hides the following toolbars:
  
  - **Find all** – makes all toolbars listed below visible on the screen
  - **Show all** – opens toolbars listed below if they were un-marked

  - **GPS** – shows / hides the toolbar controlling connection to GPS receiver, see chapter 15 [GPS support](#).
  
  - **Service** – shows / hides the toolbar used for measurements over the images block and for marker coordinates editing, see the chapter 8.8 [Marker window](#), 8.9 [Information window](#), 8.10 [Measurements over the model](#).
  
  - **Snapping** – shows / hides the toolbar, intended for editing vector objects in 2D window, see the chapter 8.1.6 [Types of snapping](#).
  
  - **Undo** – shows / hides the toolbar allowing to cancel edit operations for vector objects on 2D window, see the chapter 9.9.2 [Undo and Redo operations](#).
  
  - **Edit modes** – shows/hides the toolbar used to select of vector objects (points or polygons) editing mode
  
  - **Project management** – opens the toolbar related to project managing ([Open project](#), [Project properties](#), etc.). See the chapter 7 [Working with project](#).
  
  - **Block forming** – shows/hides the toolbar related to block forming ([Add strip](#), [Add image](#), etc) – see the chapter 4.1 [Block forming](#).
  
  - **Modules** – shows/hides the toolbar used to start [PHOTOMOD](#) modules, see the chapter 4.4 [Block processing](#).
  
  - **Load** – shows/hides the toolbar used for opening the following resources: DEM, contours, vectors and TIN. The project should be on [Processing](#) stage.
  
  - **Interpolation** – shows/hides the toolbar intended for interpolation of vertices heights for selected objects
  
  - **Batch processing** – shows/hides the toolbar which allows to process images set (see the chapters 9.3.1 [Epipolar transformation](#) and 9.4.1 [TIN creation in batch mode](#)).
  
  - **Windows** – shows/hides the toolbar used to open 2D and 3D windows and also to arrange or refresh already opened windows
  
  - **Images order** – shows/hides the toolbar used to change visual images Z-order in the block (see the chapter 8.5 [Block images order](#)).
  
  - **Selecting modes** – shows/hides the toolbar used to choose selection modes for vector objects editing in 2D window as well as for images group selection on [Block forming](#) stage. Following modes are used to select the objects:
    
    - **normal** (the icon) – selecting objects in this mode causes deselecting currently selected objects
    
    - **add to selected** (the icon) – adds objects to a group of objects already selected. Each new selected object (group of objects) is added to the current group of selected objects
▪ **subtract from selected** (the icon ![icon]) – cancels object (group of objects) selection

▪ **invert selected** (the icon ![icon]) – inverting operation. Selected objects are removed from a group if they are currently included and added to a group if they are not currently included.

  - **Group selection** – opens/hides icon panel used to choose group selection modes while editing of vector objects in 2D window and also while images group selection on Block forming stage:

    ▪ **By rectangle** (the icon ![icon]) – selects vector objects inside the rectangle "drawn" by mouse along with pressed Shift key.

    ▪ **By polygon** (the icon ![icon]) – selects vector objects inside the polygon of an arbitrary shape. Press left mouse button and Shift key to start polygon drawing. As a result you have a first vertex and a rubber-line to the current cursor position. Use left mouse button for adding vertices and double-click to finish polygon creation. The selection tools work in accordance with selected **Selection mode** described above.

▪ **Clear selection** (the icon ![icon]) – deselects all selected objects

▪ **Invert selection** (the icon ![icon]) – full invert of selection (all selected objects become deselected and all deselected objects become selected)

▪ **Refresh** (the icon ![icon] of the toolbar) – redraws a picture to show changes caused by processes in other running system modules

▪ **Arrange** (the icon ![icon] of the toolbar) – arranges windows and panels that was moved by user

▪ **Close all** – closes all windows and panels except the main menu

▪ **New 2D window** (the icon ![icon] of the toolbar) – opens new 2D window (see chapter 8.1 2D window)

▪ **Close all 2D windows** – closes all 2D windows

▪ **2D window #...** – activates 2D window (if there are several available)

▪ **New 3D window** (the icon ![icon] of the toolbar) – opens new 3D window (see chapter 8.6 3D window)

▪ **Close all 3D windows** – closes all 3D windows

▪ **3D window #...** – activates 3D window (if there are several available)

▪ **Message log** – opens a log window containing messages related to system processes

▪ **Status bar** – shows / hides a status bar in the bottom of screen showing coordinates of marker and reports of the processes occurring in the module (see chapter 8.7 Status Panel)

▪ **Marker window** (the icon ![icon] of the toolbar) – opens a window for marker coordinates editing (see the chapter 8.8 Marker window)

▪ **Information window** (the icon ![icon] of the toolbar) – opens a window to perform measurements over images block (see the chapter 8.9 Information window)

▪ **Triangulation points** – opens the window containing list of triangulation points allowing to select a point, view its coordinates and export of points list to text file
- **Block editor** (the icon of the toolbar) – opens block editor window for images and strips management on different stages of project processing. See chapters 4 [Stages of project processing](#) and 8.5 **Block editor**.

- **Project manager** (the icon of the toolbar) – opens **Project manager** window used for switching from one stage to another. See the chapter 8.8 **Project manager**.

### 9.12 Help menu

Help menu item contains the following commands:

- **Contents** (duplicated by F1 key) – runs PHOTOMOD Montage Desktop Help system
- **About program** – opens a window with the version date, software build number, etc. Click the **Modules** button to open a window with information about installed PHOTOMOD system modules on your PC. Click the **System info** button to open standard OS Windows panel containing the list of hardware and software installed on your PC.

### 9.13 Exit menu

The **Exit** button is used for PHOTOMOD Montage Desktop module closing.

### 10. PHOTOMOD Montage Desktop settings

Main menu command **Service | Preferences** opens settings panel with the following pages:

- **View** – is used to set up images visualization parameters:
  - **Size of vertex / point / node** – is used to set a size of vector points and vertices (the default value is 3 pixels)
  - **Selected point color** – shows the current color of selected point in 2D window and allows to change it in standard OS Windows color palette, called by double click on the color cell
  - **Size of current line vertex** – is used to set a size of vertex of current line in 2D window (10 pixels – by default)
  - **Current line vertex color** – shows the current color of selected vertex in 2D window and allows to change it in standard OS Windows color palette, called by double click on the color cell
  - **Background brightness** – the slider allows to change background color of 2D window from white (value 0) to black (value 255) through grayscale. Background color is grey by default (value 128). Double click of any sign (“0”, “128”, “255”) moves the slider into selected value; double click on the slider moves it back to default value – “128”. See the chapter 8.1 **2D window**.
Fig. 94 View settings

Fig. 95 Zoom settings
Zoom change step panel on Zoom tab is intended for selecting the step of image zoom in/zoom out in 2D window, when clicking the buttons  and  (or appropriate hot keys * and /). Besides, you can setup zoom changing coefficient (ratio of image pixel size and screen image pixel size), which takes place at pushing the button  in 2D window. At that in Preset zoom 1 field you can setup zoom ratio for first mouse click on  button, and in Preset zoom 2 field – zoom change on the second click. For example, if Preset zoom 1 is 1:2, then first click on  will change image size in 50% (100%:2). Second click will enlarge 100%-image in two times, i.e. will change the scale of image to 200%.

- Windows – includes following options: Automatically open 2D window (ON by default), Automatically open 3D window (OFF by default), 3D windows over other windows (ON by default).
- Marker – used to set up the type, size and color of marker. If the option Automatically select points on marker move is ON (by default) the vertices of vector object are selected in 2D window when marker is located on the vertex. If the option Snap marker to point being selected is ON, marker does not only select the nearest vertex, but also is placed in its position itself, including shift in its height. Marked option Select objects by mouth double click allows the appropriate action in 2D window after mouse double click.
- Redraw acceleration – to setup parameters of TIN and vector objects visualization in small scales using hatching. At that threshold visualization of details (regulated by appropriate sliders) shows the level of the image reducing when the objects are shown using hatching. Details visualization threshold is almost maximal by default, i.e. the objects are shown without hatching at any level of reducing (the closer the slider to min point, the faster the image redrawing).
- Block editor – allows to select actions to be performed after mouse double click on the cell with image name in the Block editor window. You can select different actions for different stages of project processing in PHOTOMOD system. See more details about Block editor in the chapter 8.5 Block editor.
Plug-ins – opens the list of available PHOTOMOD plug-ins, to turn them on/off (after system installation all plug-ins are on). It is recommended to turn off unused plug-ins to speed up the module work. There are three buttons under plug-ins list, used for convenient selecting or deselecting plug-ins in the list.

TIN – allows to setup border smoothing level when creating TIN with non-convex hull, using an appropriate slider.

System settings – influences on system processing speed and controls the data integrity supporting means. Option Maximum HDD space for autosave and undo data storage allows to set up hard disk space available for PHOTOMOD data (500 MB – by default).

- Undo – section is intended for settings concerning undo and redo operations for actions, see chapter 9.9.1 Undo and Redo operation.

Graphics mode. Used to select graphic mode: GDI or OpenGL, depending on the video card type: if your video card supports OpenGL it is recommended to select OpenGL option. Please note that the mode setting does not influence on work in PHOTOMOD modules used for stereo processing (DTM and StereoDraw).

Eppolar transformation – allows to set up images transformation options:
  - Eppolar transformation “on the fly” – if the option is ON the eppolar image of stereopair is created during vectorization process, without saving it on disk (see the chapter 9.3.1.1 Eppolar transformation “on-the-fly”).
  - Create local copies of transformed images – allows to switch off/on the creation of local copies of transformed images.

Raster
  - Use scene preview – the panel specifies the stages of project processing, when preview raster image is used in 2D window, if there is no preview scene in resources of the project. By default raster preview is created only for processing stage. See also the chapter 9.3.3 Clear scene preview.
Fig. 97 Preview visualization settings

- **Create local copy of scene preview** – allows to switch off/on creation of local copy of preview image
- **Create reduced copies of source images for faster view** – when working with a project on stages **Aerial triangulation**, **Block adjustment** and **Block processing** (if preview does not used), reduced copies of initial rasters are created automatically at project loading. These copies are stored in Photomod.var\TMP folder and during work with the project are taken from the memory. Turn the option on for: speed up the work with huge projects via LAN, when some hundreds files are open all the time, and also to speed up the block scheme refreshing
- **Do not show raster when there is no scene preview and window zoom is below 1:100** – it is recommended to mark this option when working with big PHOTOMOD projects (if preview does not used) to speed up viewing and refreshing of block scheme in 2D window. At that rasters are shown if block scheme zoom is more than indicated value.

### 11. Measurements import and export

#### 11.1 Import of measurements

If the images block was adjusted by third-party software you can import the results (interior orientation, coordinates of control and tie points and exterior orientation parameters) to the PHOTOMOD system for further processing. PAT-B or Applanix formats are used for data exchange. The data processing in PHOTOMOD system is organized as follows:
1. Create new project and add strips and images to it (see the chapter 5 New project)
2. Switch to **Aerial triangulation** stage in Project manager (see the chapter 8.4 Project manager)
1. Click an icon \textbf{Import exterior orientation} in \textbf{Project manager} window or use menu command \textbf{Operations | Import exterior orientation}. The system opens measurements import window, which contains 5 tabs:

![Fig.98 Import measurements window](image)

The window is used to set up import of the following measurements:

- Interior orientation of the project images, see the chapter 11.1.1 \textit{Import of interior orientation results}
- Exterior orientation of the project images, see the chapter 11.1.2 \textit{Import of exterior orientation results}
- Geodetic coordinates of GCP and point’s coordinates on images, see the chapter 11.1.3 \textit{Import of points measurements}.

11.1.1 Import of interior orientation results

On \textbf{Interior orientation} tab you should select file with fiducial marks measurements (with *.ino extension) for its further import to \textbf{PHOTOMOD} project, file format description see in the chapter 11.1.1.2 \textit{Format of PHOTOMOD file for interior orientation import}. At that file with camera parameters (*.cam extension) should be in the same folder.

If you would like to delete existing measurements at import, turn \textbf{on} the option \textbf{Delete fiducial measurements for images with interior orientation}. If fiducial marks are already measured on some images, their measurements are not imported, if the option \textbf{Skip images with interior orientation} is \textbf{on}. Push \textbf{OK} to start of interior orientation data import to \textbf{PHOTOMOD} project. After that its results will be displayed in the Report window, and could be saved into text file.

11.1.1.1 \textit{Data conversion from Intergraph to PHOTOMOD format}

Fiducial marks measured in Intergraph software should be converted to \textbf{PHOTOMOD} format for further use for interior orientation. Menu command \textbf{Start | PHOTOMOD | Utility | Interior orientation import} is used to open conversion dialogue window.
In this window you should select two initial files in Intergraph format, containing camera parameters (Camera file) and measurements on images (Photo file). Then input PHOTOMOD file name (format description see in the chapter 11.1.1.2 Format of PHOTOMOD file for interior orientation import). Push the button Convert to start conversion of initial files to PHOTOMOD format. As a result, two files will be saved to the same folder: with camera parameters (*.cam) and with fiducial marks measurements (*.ino). During further interior orientation import in Measurements import window you should indicate the file with *.ino extension, see the chapter 11.1.1 Import of interior orientation results.

11.1.1.2 Format of PHOTOMOD file for interior orientation import

File with fiducial marks measurements (.ino) is as the following:

```
File format with fiducial marks measurements (.ino) is as the following:
```

Fig.100 File format with fiducial marks measurements
File with camera parameters (*.cam) should be in the same folder as a file with fiducial marks measurements for import of interior orientation results.

**Fig.101 File format with camera parameters**

Refer to the chapter 12.3 Import and export of camera data to see the details about format of camera parameters file.

### 11.1.2 Import of exterior orientation data

**Exterior orientation** tab is used for exterior orientation parameters import. First you should select format of file to be imported: PAT-B (format description see in the chapter 11.1.2.1 Format of PAT-B file for exterior orientation import), Bingo (format description see in the chapter 11.1.2.3 Format of Bingo file for exterior orientation import) or Applanix (format description see in the chapter 11.1.2.2 Format of Applanix file for exterior orientation import).

Besides, you can use user-defined file format for exterior orientation parameters import, see the chapter 11.1.2.4 User defined format for exterior orientation import.
After that select **File of orientation parameters** (with .pat extension if PAT-B format is used and with .txt extension if Applanix, Bingo or user-defined format is used). The file should contain adjusted coordinates of projection centers and rotation matrices.

**Note. In some cases PAT-B file contains exterior orientation parameters, calculated for positive plane, if so, select the option PAT-B (positive)**

Note that in case of using the alpha-numerical symbols in images and points names in this file you should select the option **Allow characters in images and points names** on **Additional** tab, see the chapter 11.1.4 **Additional tab**.

If you have no file with exterior orientation parameters you should import file with adjusted coordinates of control points and measurements points on the images (see the chapter 11.1.3 **Import of points measurements**) or input GCP in **PHOTOMOD AT** module.

When the file with exterior orientation parameters is selected, you should input approximate range of heights of the terrain in **On the ground** field (Zmin, Zmax in meters), represented on the images of the block, for correct work of correlation algorithm.

If the file with interior orientation data is selected and the option **Relative orientation from Exterior orientation** is **ON** the relative orientation is calculated using exterior orientation parameters. In this case it is not recommended to use Local coordinate system (where earth is approximated by sphere). Use Cartesian (earth is approximated by plane) or “real” geodetic coordinate system. For the stereopairs with “imported” (not calculated in **PHOTOMOD AT**) relative orientation you can “redo” relative orientation inside **PHOTOMOD AT** (tab 4).

If the option **Relative orientation from Exterior orientation** is **OFF** – the relative orientation is calculated in **PHOTOMOD AT** – note that there should be enough number of tie points for stereopair.
Note: When importing exterior orientation, it is necessary to verify that the X-axis
direction of the camera, set in the PHOTOMOD project, coincides with the flight
direction.

11.1.2.1 Format of PAT-B file for exterior orientation import

File of exterior orientation parameters (with .pat extension) contains adjusted coordinates
of projection centers and rotation matrices.

First number in each string is a number of the image followed by “0” value and X, Y, Z
coordinates of projection centers. In the next two lines are 9 values of the rotation matrix
elements (3X3) – five values in the first line and four in the second, see Fig.77. Items
separator is either space or comma.

Matrix elements are calculated by following formulas and entered in following order:

\[
\begin{align*}
    a_{11} & = \cos \phi \times \cos \kappa \\
    a_{21} & = \cos \kappa \times \sin \phi \times \sin \omega + \cos \omega \times \sin \kappa \\
    a_{31} & = -\cos \kappa \times \sin \phi \times \cos \omega + \sin \omega \times \sin \kappa \\
    a_{12} & = -\sin \kappa \times \cos \phi \\
    a_{22} & = \cos \kappa \times \cos \omega - \sin \omega \times \sin \phi \times \sin \kappa \\
    a_{32} & = \sin \omega \times \cos \phi \\
    a_{13} & = \sin \phi \\
    a_{23} & = -\sin \omega \times \cos \phi \\
    a_{33} & = \cos \omega \times \cos \phi
\end{align*}
\]

Refer to PHOTOMOD Solver User Manual for more details on images exterior orientation
angular parameters \(\omega, \phi, \kappa\).
11.1.2.2 Format of Applanix file for exterior orientation import

Fig.104 File sample with exterior orientation parameters in Applanix format

File delivered along with digital aerial images contains information about camera parameters and images exterior orientation data. Refer to the web-site [www.applanix.com](http://www.applanix.com) for detailed description of the format.
11.1.2.3 Format of Bingo file for exterior orientation import

If there is an exterior orientation parameters file obtained after data processing in IGI company software (Germany), it is in text format and you can import it to PHOTOMOD system.

Fig.105 File sample with exterior orientation parameters in Bingo format

11.1.2.4 User defined format for exterior orientation import

Exterior orientation data could be imported from text file of user defined format. Select the option User template on Exterior orientation tab and push the button ... Window opened allows to describe parameters of data storing in file to be imported.
Fig. 106 User defined file format

First define number of columns in each raw of the file in appropriate field, then input number of columns which contain the following exterior orientation parameters: image ID (Image field), X, Y, Z coordinates and angular elements omega, phi, kappa. Select units of angles measurements in the file in Angular units panel (degrees, grads, radians).

You can save defined template with name input to the Template filed by pushing the button (Save). Push the button (Delete) to delete the template.

When all the parameters of user file are setup push OK and on the Exterior orientation tab in the Import exterior orientation window, specify path to file in the File of orientation parameters field, see the chapter 11.1.2 Import of exterior orientation data.

11.1.3 Import of points measurements

If you have no file with exterior orientation parameters you should import file with adjusted coordinates of control points and measurements of points on the images. To start import open Point measurements tab and select File of points adjusted coordinates with .xyz extension, format description see in the chapter 11.1.3.1 Format of file for import of geodetic point's coordinates.
Then on Point measurements tab in Measurements file (Input file of photographs) field select file with .mea extension. The file contains point’s coordinates measured in the image coordinate system in mm or mkm (Measurement units option). If the coordinates are corrected for distortion and principal point offset you should select the option Camera parameters taken into account. Format description see in the chapter 11.1.3.2 Format of file for import of points measurements on images.

Note that in case of using the alpha-numerical symbols in images and points names in this file you should switch on the option Allow characters in images and points names on Additional tab, see the chapter 11.1.4 Additional tab.

If you need to change right-handed coordinate system into left-handed one, or vice versa during import, you should select the option Swap X and Y coordinates on Additional tab, see the chapter 11.1.4 Additional tab. So after import X and Y points coordinates will swap places.

If you have no file with adjusted coordinates of ground control points you should add ground control points in PHOTOMOD AT or import file with exterior orientation parameters (in PAT-B, Bingo or Applanix format), see the chapter 11.1.2 Import of exterior orientation data.

11.1.3.1 Format of file for import of geodetic point’s coordinates

File of control points of adjusted coordinates has .xyz extension. Its first column contains control point number and other 3 columns contain X, Y, Z coordinates of the control point respectively. Use space or several spaces as a delimiter.
11.1.3.2 Format of file for import of points measurements on images

Measurements file (Input file of photographs) has .mea extension. The file is divided into sections corresponding to each image. The section is started from an image number which is followed by focal length value and “0” value. Then, lines consisting of point number, X and Y coordinates with respect to the principal point and “0” value follow. The section is ended with “-99” value. One or several space characters are used as a delimiter.
11.1.4 Additional tab

Note that in case of using the alpha-numerical symbols in images and points names (in files with *.pat and *.mea extensions, see in the chapters 11.1.2.1, 11.1.3.2), you should select the option Allow characters in images and points names on Additional tab and select file in the field Images numbers and images names matching file.

![Sample of images numbers and names matching file](image)

Fig.110 Sample of images numbers and names matching file

The file contains two columns, which are linking Numbers of photos from files with *.pat or *.mea extensions and corresponding images Names in PHOTOMOD system. You can also edit PHOTOMOD image names in PHOTOMOD Desktop module when you add them to the project or later in PHOTOMOD Explorer to make them exactly the same as PAT-B image numbers. In this case this file is not required and option Allow characters in images and points names should be turned off.

If you need to change right-handed coordinate system into left-handed one, or vice versa during import, you should select the option Swap X and Y coordinates on Additional tab, and after import X and Y points coordinates will swap places.

11.1.5 Completing of measurements import

On the Adjustment tab of Import of measurements window you should select the way of import completing:

- Go back to PHOTOMOD Montage Desktop – the report window with import results will be opened after import.
- “Exterior” adjustment from ground control points – if file with geodetic coordinates of ground control points was selected for import on Point measurements tab, after pushing OK button the exterior orientation parameters will be calculated using these points. After that you can transfer your project to the Block processing stage.
- “Exterior” adjustment from exterior orientation parameters – if exterior orientation data file (of PAT-B or Applanix format) was selected for import on Exterior orientation tab, after pushing OK button the window with adjustment results will be opened. After that you can transfer your project to the Block processing stage.
11.2 Export to PAT-B format

After aerial triangulation executed in PHOTOMOD AT you can go further from Aerial triangulation to Block adjustment stage using, for instance, Project manager. It is possible also to adjust the blocks in external software. In this case you should export the aerial triangulation results to PAT-B format, by clicking the icon Export to PAT-B in Project manager window. The following dialogue panel appears:

First select the folder for the export data in PATB project folder field, and then select the export options considering the following conditions:
- if alpha-numeric symbols in images and points names should be preserved after export, select the Export names option;
- if resulting file should correspond to strict PAT-B format (without alpha symbols), select the Export ID's option. At that inner PHOTOMOD system identifiers will label images and points in resulting files.

As a result files with extensions .mea and .xyz are created in the selected folder, which are analogous to those described in the chapter 11.1.3 Import of points measurements.
11.3 Import of adjustment results

If aerial triangulation and/or block adjustment were executed in external software, but further processing is supposed to be done in PHOTOMOD system, it is possible to import the data using PAT-B format. For that, click the icon **Import adjustment results** in Project manager window, when the project is on Block adjustment stage.

The panel appeared (Fig.113) contains two options: **Use exterior orientation parameters** and **Use adjusted points**. In the first case *.pat* file should be available (see the chapter 11.1.2.1 *Format of PAT-B file for exterior orientation import*). If **Use adjusted points** option is selected (preferably) – use *.xyz* file (see the chapter 11.1.3.1 *Format of file for import of geodetic point’s coordinates*). If file with triangulation points’ coordinates is used, it is necessary to select an additional option **Import names** or **Import ID’s**, according to the conditions described in chapter 11.2 *Export to PAT-B format*.

![Fig.113 Import exterior adjustment](image)

Successful import process results appear in the information window with report of orientation errors (see Fig.113).

![Fig.114 PAT-B import results](image)
12. Catalog of cameras

12.1 Entering camera passport data

The catalog of cameras (opened by the icon or Modules | Camera editor option) is used to enter and edit camera parameters. This catalog is created separately from the projects, since any camera may be used for several projects. At the same time (in general case) some project can contain images acquired by different cameras. You should select a camera corresponding to the image or to the block of images at the step of Interior orientation (PHOTOMOD AT) – see PHOTOMOD AT User Manual.

Click the icon of the main button bar to open Camera editor:

![Camera editor window](image)

Fig.115 Camera editor

If there is camera’s database in PHOTOMOD system, you can push the button in this window and select proper database from the list appeared. After that in Cameras editor window the list of cameras available in this database will be visualized. The window allows to delete camera (by pushing the button ), import/export it into text format (using the button or respectfully, see the chapter 12.3 Import and export of camera data) or input new camera as described below.

The button is intended for import camera, used for processing of other PHOTOMOD projects, see the chapter 12.3 Import and export of camera data. Use the button to exit Cameras editor.
If you need to create camera with parameters similar to existing ones, create a copy of selected camera (by pushing the button \texttt{Copy camera}) and after changing parameters, save it as a new camera.

To input new camera data into database, use \texttt{Camera} window (opened by clicking the buttons \texttt{ or }\texttt{ }), where the following fields are to be filled in (or edited):

\begin{itemize}
  \item \textbf{Camera} – arbitrary name up to 16 symbols length,
  \item \textbf{Calibration date} – date of camera calibration,
  \item \textbf{Description} – camera description that is helpful to identify the camera and projects in which it has been used,
  \item \textbf{Units} – to be selected from the list. Selected units are used to enter camera calibration data: \textbf{Focal length} and \textbf{Principal point coordinates (offsets) Xo, Yo}. If calibration data are not available, Xo, Yo are set to 0.0.
  \item \textbf{Fiducial marks data} – this panel contains the list of options to be selected according to the available camera calibration data.
    - \textbf{Principal point} – is used for interior orientation, if there are not calibration data and fiducial marks available. Should be input in pixel coordinates.
    - \textbf{Calibrated distances} – allows to input calibrated distances Lx, Ly between fiducial marks located on the opposite image edge. Click the \texttt{ icon and input data in the window opened.
    - \textbf{Fiducial coordinates} – allows to input calibrated X, Y coordinates of the fiducial marks. Click the \texttt{ icon and input data in the window opened.
    - \textbf{Fiducial marks} – fiducial marks positions are used for interior orientation, if there are not calibrated fiducial marks coordinates or distances available.
    - \textbf{Digital camera} – allows to input digital camera parameters in the window opened after clicking the icon \texttt{}, see the chapter 12.2 \texttt{Digital camera parameters input}.
\end{itemize}
• **Distortion** – this panel contains the list of options to be selected according to available camera distortion data.
  - **No data** – no distortion data available
  - **Formula** – used to input a set of “Brown-Conrady” model coefficients
  - **Radial** – used to input a set of distortion values depending on distances from the principal point
  - **4 directions “+”** – used to input a set of distortion values along the axes of the image coordinate system
  - **4 directions “X”** – used to input a set of distortion values along the diagonal directions
  - **8 directions** – used to input a set of distortion values along the axes of the image coordinate system and diagonal directions.

When entering the distortion data you should input coordinates of the symmetry point (zero distortion point) and the distortion data either as a table or a formula.

Click the ![icon] icon in Distortion panel and input distortion data in the window opened. The example on Fig.117 shows the case of **8 directions** distortion data set.

The upper table in the window corresponds to the 1-2-3-4 directions, the lower – to the 5-6-7-8 directions. The scheme of directions is shown to the right of the corresponding table. Each line of both tables contains the distance from the point of symmetry in the first column and the distortion values in the other columns corresponding to the different directions. To move along the tables, add, delete or edit lines, use the set of buttons below the tables.

**Note. Both distortion values and radial distances from the principal point should be defined in equal units selected in the Units menu of the Camera window, regardless of which form (table or formula) is used to enter distortion data.**
Note. Camera editing does not change the camera parameters in all projects that use this camera. To change the camera in the project, “re-link” it in PHOTOMOD AT module.

Note. PHOTOMOD system takes into account a distortion as follows: a point position on an "ideal" (free of distortion) image is equal to its position on the real image PLUS the value from the distortion table. You should input passport data carefully since there is no common rule for distortion signs and they could be opposite for some cameras passports. Thus, in case of poor results of block adjustment, try to input distortion coefficients with the opposite sign.

12.2 Digital camera parameters input

When processing data acquired by digital camera you should input its parameters and remember that all of them (principal point coordinates, distortion coefficients, focal length) should be input in the same units – either pixels or millimeters. You can choose proper units in Units panel in Cameras editor window.

![Input of digital camera parameters](image.png)

In most cases all parameters of calibrated digital cameras included into camera passport are in the same units. Otherwise you should recalculate them. For instance, if pixel size of camera matrix is known, you can convert camera focal length from millimeters into pixels.

Note. The survey should be done with the same resolution and zoom which were used for camera calibration (if camera type allows surveying with different resolutions)

Input of digital camera parameters is described in details in PHOTOMOD AT User Manual.

12.3 Import and export of camera data

Camera parameters could be imported from text file or from another PHOTOMOD project.
Use the button - import camera on Camera editor panel to import camera data from another project (see the chapter 12.1 Entering camera passport data). This button opens a list with available projects containing camera’s data in Project management window (see the chapter 7.1 Project management). After selecting the project (by double mouse click) its camera will be added to the current cameras database and shown in Camera editor window.

You can also import camera parameters from text format file using the button in Camera editor panel. After that chose file with *.cam extension:

![Camera parameters file format](image)

Camera parameters file contains the following parts:

[Camera]
Name – camera name
Type – camera type
Units – measurement units (1 – pixel, 2 – mm)
Focal – focal length
X₀Y₀ – principal point coordinates
Distortion type – according to types shown in Camera window (Fig.113)

[Marks]
Fiducial marks data

[Distortion]
Distortion parameters

Please refer to Technical Support Department of Racurs Company for more details on the file format.
Export of camera data, selected **Camera editor** panel, into text format is started by clicking the button 📐. It is also useful to view exported file with existing camera data for creation the same new camera file for its further import into cameras database.

### 13. Image Wizard

**PHOTOMOD Image Wizard** utility is intended for performing different operations with initial images prior to input them to PHOTOMOD system.  

Normally all the necessary operations with images are performed automatically during the project creation and changes made in the Montage Desktop module. Nevertheless, manual adjustment of images can be required in some cases. For example, if a project has been restored from a backup copy, which had no initial images, then initial images kept as separate files cannot be added automatically from the files to the project during the restoration process.

Operations provided include addition of external files, connection of the images that are already in the resource system as well as “fake” images creation for the project. The latter option is useful, when the initial images are unavailable somehow while certain operations with the project are needed to be done for which initial raster information is not required (i.e., available TIN, DEM view or export etc.).

**Note. You should remember that incorrect use of the Image Wizard functionality could lead to the project processing failure in other PHOTOMOD modules**

Even though the project operational state could be restored quite easily in that case, it is highly recommended to avoid any operation with project images if you are uncertain about the result. In case of some hesitation, please, contact Technical Support Service.

#### 13.1 Image Wizard start

**Image Wizard** is launched from **PHOTOMOD Montage Desktop**, as well as from Start menu Shortcut.

- Start from Montage Desktop module by pushing the icon 📐 Image Wizard in **Project management** window toolbar if some project is selected (see the chapter 7.1 **Project management**). At that the Wizard will open this project automatically while launching.

- After PHOTOMOD system installation the shortcut **Image Wizard** is created in Start menu automatically (by default it is located in the following folder **Start | Programs | PHOTOMOD | PHOTOMOD Image Wizard**). While launching by this way the Wizard suggests to select the project using standard dialogue **Open**. Select the project and push the button **Open** (or double click it), to open the project and pass to the main Wizard window.

#### 13.2 Principle of operation

Image Wizard works with PHOTOMOD project images. Each PHOTOMOD project contains detailed information about all its initial images (raster size and color, interior and exterior orientation parameters etc.). Since each initial image may be used by several projects, so initial images are stored out of the project. Only the links to these images are stored in each project.
Main function of the Image Wizard is images links management, i.e. association the information about project images with real rasters as well as validation of such links using the data available in project.
Each project image could be matched with the following data:

- **External file.** At that, the file is added to PHOTOMOD resources structure, and becomes usual project image.
- **Existing PHOTOMOD resource.** At that, no new data structures are produced.
- **Fake raster.** At that, new raster image resource is created. It is filled in with a certain background, with size and color corresponding to the project image data. It allows working properly with this raster in all PHOTOMOD modules, where the image information is not used.

All changes are applied in batch mode after pushing the Apply button in Project images group. The rest Wizard controls could not produce changes to the project and are used only for changes report creating.

### 13.3 Wizard main window

After Wizard launching and PHOTOMOD project opening, the main Image Wizard window opens.

The window consists of the following elements:

**Title bar**
In window title bar you can see module name and the name of opened project in brackets.

**Tool bar**

Tool bar contains the following buttons:

- **Open** – opens PHOTOMOD project
- **Show image properties window** – opens a window with detailed information about the project image selected
- **Show image change parameters report window** – opens a window with detailed information about operation assigned to the project image selected
- **Exit** – closes Image Wizard program
- **Export selected images** – opens a window for target folder selection for file with image in PHOTOMOD format. This option is useful for images copying from one project to another using just PHOTOMOD format.

**Project images**

Project images group contains project images list with parameters of each image; brief description of operation with image scheduled; selected image preview panel; buttons for operations management and the field intended for compression quality management of images added to the project or re-compressing them insight the current project. Images compressing algorithms (JPEG or LZW) are the same as those applied at images adding to PHOTOMOD system in Montage Desktop module, see the chapter 5.2.1 Adding central projection image to the project.

![Project images](image)

Fig.121

You can resize preview panel by dragging of vertical line located leftward from the panel. You can also turn on/off image preview using the check box Preview below preview panel. You can resize Project images group by dragging of horizontal line located under group panel.

**Operations**

Operations panel contains the buttons used to change selected or all images of the project. Refer to the chapter 13.4 Main operations for detailed description of buttons functions.

**Source**
Source panel contains initial data lists, grouped into tabs according to their types (Resources, Projects, Files), and also the panel to preview the source raster selected. The source image can be connected to the current project.

![Source panel](image)

Fig. 122

You can resize source preview panel by dragging vertical line located leftward to the panel. You can also turn on/off image preview using the option Preview located below the Preview panel.

**Resources tab**

Resources tab shows rasters available in PHOTOMOD system resources.

The information is displayed in two panels as in PHOTOMOD Explorer module. The subfolder Rasters is available in PHOTOMOD system resources.

**Projects tab**

Projects tab allows to select rasters available in PHOTOMOD resources system, grouped into the projects, however. If the project is selected on the left panel, the right will contain all project’s images.

**Files tab**

Files tab contains available files list, allowing to select rasters in it to link them to the project. This information style and contents are similar to Windows Explorer.

### 13.4 Diagnostics tools

Image Wizard provides the set of tools intended to facilitate integrity control of data, related to project images, and also to control images operations correctness.

**Project images list**

Project images list contains brief information about project images, links with rasters correctness and also about operations with the images.

It is in form of table that consists of the following columns:
### Project Images

<table>
<thead>
<tr>
<th>Name</th>
<th>Current</th>
<th>Parameter</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image 1707</td>
<td>Block</td>
<td>11002 x 11254 @ 24 bpc</td>
<td></td>
</tr>
<tr>
<td>Image 1708</td>
<td>Block</td>
<td>11002 x 11254 @ 24 bpc</td>
<td>U</td>
</tr>
<tr>
<td>Image 1709</td>
<td>Block</td>
<td>11002 x 11254 @ 24 bpc</td>
<td>C 11002 x 11254</td>
</tr>
<tr>
<td>Image 1700</td>
<td>Block</td>
<td>11002 x 11254 @ 24 bpc</td>
<td></td>
</tr>
<tr>
<td>Image 1701</td>
<td>Block</td>
<td>11002 x 11254 @ 24 bpc</td>
<td></td>
</tr>
<tr>
<td>Image 1702</td>
<td>Block</td>
<td>11002 x 11254 @ 24 bpc</td>
<td></td>
</tr>
<tr>
<td>Image 1703</td>
<td>Block</td>
<td>11002 x 11254 @ 24 bpc</td>
<td></td>
</tr>
<tr>
<td>Image 1704</td>
<td>Block</td>
<td>11002 x 11254 @ 24 bpc</td>
<td></td>
</tr>
</tbody>
</table>

- **Name** – image description in the project. This description is shown near the project image while viewing it in PHOTOMOD Explorer. It can differ from the inner name, used during project processing, for example, in **Montage Desktop** module. The parameter is unchangeable.

- **Current** – raster name, corresponding to the image. Column content is refreshed automatically after completing the operation over the image. If no raster is linked to the image, the appropriate cell is blank.

- **Parameters** – raster parameters according to the data indicated in the project. The parameters are unchangeable. Raster linked as a project image should conform these parameters, otherwise some errors would occur during the project processing in PHOTOMOD system.

- **Operation code** *(column without header)* – contains code of the operation assigned. Possible symbols are: F – file adding; R – raster linking; P – linking image from another project; U – unlink raster from the project; C – fake raster creation. Refer to the chapter 13.5 **Main operations** for details.

- **Change** – brief information about operations performed with the image. Its format depends on exact operation. Detailed information is shown in the **Change operation properties** window. Refer to the chapter 13.5 **Main operations** for details.

If the project image has not link to the raster, or raster linked to it is unavailable or has mismatched parameters, the appropriate cell (**Current**) has red background.

If operation assigned to image is impossible (for example, file specified do not contain the raster), the appropriate cells (**Operation code** and **Change**) have light red background.

If the operation assigned to image results in raster matching with parameters different from those indicated in the project, the appropriate cells (**Operation code** and **Change**) have yellow background.

List of project images supports group rows (images) selection. For group selection select the first and the last images of the group along with pressed **Shift** key.

**Image properties window**
The window is opened automatically at Wizard launching, and also can be opened later using appropriate toolbar button.

It contains detailed information about the image selected in project images list. If the image is damaged, or link to the real raster is damaged or incorrect, you will receive detailed diagnostics.

The information is refreshed automatically after image selecting.

### Change operation properties window

<table>
<thead>
<tr>
<th>Image: Image sc1707</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation: create lake image. Create and add to project fake raster with parameters: 11002 x 11254 @ 24 bpp. Raster is filled with grayscale cyclic gradient fill.</td>
</tr>
<tr>
<td>Operation status: OK</td>
</tr>
</tbody>
</table>

Is opened by pushing the appropriate button on tool bar.

The window shows detailed information about operation assigned to the image selected in project images list. If the operation cannot be done for some reason or can result in incorrect work with project, you will receive detailed diagnosis.

### Preview panels

Panels for source image and project image preview allow to zoom and scroll the image to view its different parts.

- Use “*” and “/” keys of numeric keyboard to change the image scale.
- Use scroll bars located along the panel edges to scroll the image, or drag the image along with pressed **Alt** key.

### Report saving
The Report button in Project images panel of the main window allows to save all information, shown in image properties window for all project images in one text file, for instance, for sending it to the Technical Support Service in case of any problems with the project. In popup dialogue window input file name and push the Save button to create the report. After that you will get the appropriate message Report created successfully.

13.5 Main operations

Standard workflow in Image Wizard program is as follows:

- Project loading
- Listing operations with images
- Implementation of changes

Project loading

PHOTOMOD project is loaded automatically during the Wizard launch from the Montage Desktop module. You can also use the Open button to load it.

Images operations list drawing up

The data will only be changed after pushing the Apply button. No changes are made before the button is pushed. Operations’ assignment to the images is only to list them, without changing any project data structure.

Operations panel buttons are using for assigning operations to images.

The result of each operation depends on images, selected in project images list and on the objects, selected in the Source panel:

Replace image

You can match the image selected in project images list (group selection is not supported) with object selected in the Source panel. Matching process depends on the tab selected in the Source panel and proceeds as follows:

- Resources tab is selected

At that, the resource with raster data, selected in the right panel is used. If the condition has been met, in Operation code column “R” symbol appears, and in Change column full description of the resource is shown. After applying the change, the resource is added to the project without creation of new data structures.

If selected resource does not contain information on raster you will get an error message.

- Projects tab is selected
At that, the operation uses the raster, matched with project image selected in the right panel. In **Operation code** column “P” symbol appears, and in **Change** column the name of the project and image selected is shown.

- **Files tab is selected**

File selected in right panel is used. In **Operation code** column “F” symbol appears, and in **Change** column – full file path.

**Auto-match selected**

**Auto-match all**

These operations perform the same, but **Auto-match selected** applies the changes only for selected images (group selection supported), and **Auto-match all** - for all project images. In both cases only images without assigned operation will be processed. The exact auto-matching algorithm depends on active tab in the **Source** panel (data in columns **Operation code** and **Change** in project images list will be filled analogously to option **Replace image** described above):

- **Resources tab is selected**

  In resource fork, selected in the left panel, the resource with raster information where initial file name is the same as inner name of the image is searching for each processing image.

- **Projects tab is selected**

  In project selected in the left panel the image with the same inner name is searching for each processing image.

- **Files tab is selected**

  In directory selected in the left panel the file with the same name as inner image name is searching for each processing image.

**Unlink selected**

Link to raster will be deleted for selected images (group selection supported). **Source** group status does not influence on this operation. In **Operation code** column “U” symbol corresponds to this operation. **Change** column is empty.

Images unlinking could be useful when correcting some errors occurred while project copying or restoring from backup as well as when performing some other non-standard operations with projects.

**Attention! After this operation some errors may occur while project processing in PHOTOMOD system! Use this operation only if you are convinced about the result!**

**Create fake images**

Fake rasters with appropriate color, size and pattern filling are creating for images selected (group selection supported). These rasters are in MSTIFF format with deep JPEG-compression, to reduce the volume (compression quality management does not influence on this operation). **Source** group status does not influence on this operation. In **Operation code** column “C” symbol is corresponding to this operation. In **Change** column the size of creating raster is indicated.
If erroneous operations were assigned to some images, you can cancel them (before pushing the **Apply** button) using the following buttons in **Project images** panel:

- **Reset selected** – to cancel the operations assigned to the images selected in the project images list.
- **Reset all** – to cancel all operations assigned to all project images.

After operation canceling it is impossible to restore it.

**Recompress selected**

You can change compression level and type for selected images using appropriate button **Recompress selected**. Such process uses compressing parameters setup on the panel **Add/recompress files with compression** (see the chapter 13.3 **Wizard main window**). Files will be recompressed in two stages: raster image is converted into file and saved in PHOTOMOD.VAR\Undo folder (at that file name is the same as image name in project). Then the image is copying back to PHOTOMOD resource and could be viewed using **PHOTOMOD Explorer** utility, see **PHOTOMOD Overview**. In case of successful copying the file will be deleted from PHOTOMOD.VAR\Undo folder. If the conversion failed, the file will be not deleted from the folder that allows to restore the image in this case. You should keep in mind deleting unused files from PHOTOMOD.VAR\Undo folder.

**Changes applying**

After scheduling all changes, which you would like to take place in the project, push the **Apply** button in **Project images** panel. At that, process displaying window pops up.

Push **Pause**, to stop the operation (at that the **Pause** button is substituted by the **Continue** button and you can push it to resume the operation).

Push **Cancel** to interrupt the operation.

*Note: As the interruption occurs immediately, long-term operation (fake raster building or adding the image from file) can be interrupted before the end and that can result in incomplete raster image displaying.*

**Notes**

**Adding files from removable media**

It is possible to add external files to PHOTOMOD resources system from several removable media (for example, CD- or DVD-Rom). At that, operations assigning passes as usually but you should insert the media in turn in order to make up the whole operations list. After that while changing applying the Wizard will ask you to insert new media if needed file will be not found in current configuration.

**Undo changes**
After applying the changing to the project it will be impossible to cancel changing by the Reset selected or Reset all buttons. If you would like to cancel the operation result, input initial images information as usual (it is possible because, while matching new rasters, the rasters matched to the project images previously, had not been deleted), and then apply them. You may delete unnecessary files if needed, using PHOTOMOD Explorer (only if you are convinced absolutely that rasters intended to deletion are not used by any project).

14. Block scheme editor

PHOTOMOD Scheme Editor module is intended for compilation of PHOTOMOD project block scheme for its further printing or export to EMF format, which could be edited in some graphic software afterwards. It could be launched from OS Windows START | Programs | PHOTOMOD | PHOTOMOD Scheme Editor menu or pushing the icon  from Project management window of PHOTOMOD system (see the chapter 7.1 Project management).

The block scheme built in this module contains the following:
- images outlines
- strips outlines
- images names
- set of arbitrary vector layers, loaded from vector format resources of PHOTOMOD system.

At that you can:
- load ready-made block schemes:
  - corresponding to project’s block forming stage
  - saved in PHOTOMOD AT
  - corresponding to project’s block processing stage
- load vector objects from resources (including block pre-regions)
- rotate the entire scheme
- move strips in drag-and-drop mode
- change size rate of separate images and the entire scheme for images overlapping area changing
- change images names font size
- change lines thickness for images and strips contours
- change color of all images of selected strip
- change color of selected vector layer
- turn on/off strips contours
- save and load the scheme created (excluding set of loaded vector layers)
- print scheme (at that it will be automatically fitted to standard A4 sheet in portrait orientation)
- export the scheme into EMF format for advanced editing.
**Main program menu**

Main menu contains the following items:

**Project** menu:

- **Open project** (or the icon ![ ] ) – opens standard dialog window for PHOTOMOD system project opening
- **Exit** (or the icon ![ ] ) – exits from **Block scheme editor**.

**Scheme** menu:

- **Load...** (or the icon ![ ] ) – loads block scheme from resource (opens standard resource opening dialog)
- **Save** (or the icon ![ ] ) – saves the scheme to the same file
- **Save as...** – allows to select new file name
- **From stage 0** – loads block scheme according to its view in **PHOTOMOD Montage Desktop** module on Block forming stage
- **From stage 1** – loads block scheme created in **PHOTOMOD AT** module by appropriate command
- **From stage 2** – loads block scheme according to adjusted project on the Processing stage
- **Export to EMF format** (or the icon ![ ] ) – allows to save the scheme to EMF format
- **Print scheme** (or the icon ![ ] ) – opens printing dialogue
- **Objects**:
  - **Load...** – opens standard dialog window for loading vector objects from resource
- **Clear** – deletes all loaded vector layers

**View menu:**
- **Zoom in** – enlarges scheme scale
- **Zoom out** – reduces scheme scale
- **Zoom to fit** – fit the block scheme in the window
- **Control window** – opens **Scheme control** window if it was closed

Besides, on the tools panel there is font size management field (in relative units), and also the button **Show strip frames** used to turn on/off strip frames view.

**Working area**
In working area you can view block scheme as it will be on print copy or in EMF format.

To adjust the view, use the following operations:
- Select the strip by mouse click insight it. To unselect the strip click outside all of them
- Press Ctrl and move highlighted strip in drag-and-drop mode
- Zoom image using mouse wheel or "*" and "/" Numpad keys
- Press and hold "R" key and move the mouse with pressed left button to rotate the entire scheme
- Use the mouse wheel along with pressed "Shift" key to change font size of images names
- Use the mouse wheel along with pressed "Alt" key to change line thickness bordering images and strips
- Use the mouse wheel holding "S" key to change frames sizes of images in highlighted strip or in all strips if no one selected.

"**Scheme control**" panel
**Scheme control** panel is opened either as an independent window or docked to the left or right edge of the window.

**Strips** table contains the list of all project strips and is intended for their color setting. Use mouse click for strip selection or double click on colored cell rightward to the strip name to change its color.

**Objects** table contains the list of all vector layers loaded with indication of resources names from which they were loaded and allows to adjust their color. Use mouse double click on colored cell rightward to the layer name to change its color.

**Status line**
In **Status** line you can see the following:
- in left section: "*" sign if the scheme was changed after the last loading/saving
- in right section: resource description where was the last scheme loading/saving.

15. **GPS support**

15.1 **General description**

PHOTOMOD has a basic support for GPS receivers which can be connected to the computer via serial (COM) port, whether real or virtual (over USB, Bluetooth, TCP/IP), and can transmit navigation data in NMEA protocol. With such receiver connected, GPS data may be displayed in a special window (see chapter 15.6 **GPS monitor**), as well as marker synchronization with GPS (automatic marker movement to a point with coordinates read from the receiver). For the latter feature to function properly, to conditions must be met:

- Working coordinate system of the project must support converting coordinates to/from WGS 84. When working without the project, such coordinate system must be loaded with menu command **Service | Coordinate** system.
- Working area of the project must include the position of the receiver.

GPS connection is controlled with the menu **Service | GPS** and the **GPS** toolbar (see chapter 15.5 **Working with GPS**).
GPS supported is implemented identically in Montage Desktop, DTM, StereoDraw, StereoVectOr, GCP Survey modules. Description in this chapter relates to all these modules.

It should be noted that without special means for sharing serial ports, GPS receiver may be used at a time by only one program, in particular by only one PHOTOMOD module instance.

15.2 Hardware requirements

Only GPS receivers communicating in NMEA protocol via COM port are supported, including but not limited to Garmin GPSmap76CSx, Garmin GPS72, Garmin eTrexH, Trimble R8, and other makes and models, outputting NMEA messages GPRMC or GPGGA.

To perform initial connection of a receiver to the computer, refer to receiver’s user manual. If connection setup in PHOTOMOD fails after following this User Manual, please first check the connection with other programs.

15.3 Connecting receiver

Only the receivers communicating in NMEA protocol are supported. Connection is done via serial port. Any physical COM port may be used (integrated in the motherboard, separate PCMCIA or USB to COM controller), as well as hardware or software means of connecting a device via virtual COM port, e.g. Bluetooth receivers. In the latter case, port setup dialog may be unavailable in PHOTOMOD, and special software may be necessary to configure the port.

15.3.1 Garmin receivers

The following models support has been verified:

- **Garmin GPS 72**. In the receiver setup menu, data output must be set to NMEA Out and working datum must be set to WGS 84.
- **Garmin eTrexH**. In the receiver setup menu, data output must be set to NMEA Out and working datum must be set to WGS 84.
- **Garmin GPSmap 76CSx**. Check the following settings in the receiver setup menu: in «Main Menu | Setup | Interface | Serial Data Format» set «NMEA In/NMEA Out», in «Menu | Advanced NMEA Setup» check «GPS Status (GSA, GSV)», «GARMIN Proprietary», uncheck «Autopilot Mode (APB,...)»; the state of «Waypoint/Route (WPL, RTE)» option makes no difference; precision should be set to maximum: «XX.XXXX (4 digits)». In geodetic datum setup «Main Menu | Setup | Units | Map Datum» set «WGS 84».

15.3.2 Trimble receiver

The following model support has been verified:

- **Trimble R8**. It is necessary to use Trimble configuration software to enable output of all types of NMEA messages to the receiver port 2. Output interval should be set equal for all messages, 1-2 seconds is enough. Transmission speed should be set to maximum (115200), if it does not lead to transmission errors. Also, standard NMEA speed of 4800 bps may be set, but in this case either the message interval has to be increased to 5-10 seconds, or some NMEA messages (GPGSV, PTNL-PJK, PTNL-VGK, PTNL-VHD, PTNL-AVR) should be disabled.

15.3.3 Other receivers

Support for any other receivers, transmitting NMEA messages GPRMC or GPGGA, is generally assumed though not verified. For the correct coordinates readout, NMEA datum in the receiver should be set to WGS 84 (in Garmin receivers, for example, NMEA datum is equal to working datum).

15.4 Communication setup

To setup connection to the receiver, click the toolbutton or choose menu command Service | GPS | Setup.
In the dialog which is brought up by the command, one should:

1. Select COM-port, to which the receiver is connected, in the **COM-port number** field.
2. Set up the port. Common values for NMEA (4800 bps, 8 data bits, no parity, 1 stop bit, no flow control) are reset by the **Set NMEA defaults** button. Nonstandard parameters may be set up by clicking the **Setup port** button.

**Note.** The **Setup port** button may be unable to bring up the setup dialog for nonstandard or virtual ports, such as serial-over-bluetooth ports.

3. Select the receiver type in the **Receiver model** field:
   - **Garmin GPS 76 / 72 / eTrexH** — Garmin GPSmap76CSx, Garmin GPS 72 or Garmin eTrexH receivers, set up as mentioned in 15.3.1 **Garmin receivers**. This setting would probably suit other Garmin receivers.
   - **Trimble R8** — Trimble R8 receiver set up as described in 15.3.2 **Trimble receiver**.
   - **Generic (RMC)** — any receiver outputting the GPRMC message. In this mode only the following data is obtained: latitude, longitude, elevation, time, horizontal speed, heading and fix state.
   - **Generic (GGA)** — any receiver outputting GPGGA message. In this mode only the following data is obtained: latitude, longitude, elevation, time, fix quality (number of satellites, HDOP).
   - **Generic (all)** — any receiver outputting the messages GPGGA, GPGLL, GPGSA, GPGST, GPGSV, GPRMC, GPVTG, GPZDA, PGRME, PGRMM, PGRMZ, PTNL. End of data relating to one fix is derived from the timestamps. Due to this, some instability may occur when working with receivers outputting current timestamp instead of fix timestamp in every message (e.g. the receiver integrated in PDA Asus A639).

4. Test the connection clicking the button **Start reception**. If the setup is valid, the **Data log** should start displaying raw NMEA messages from the receiver, and if the latter is
able to track satellites and obtain the position, fields in the **Current location** group should display parsed data.

In the **Data log**, valid lines (with matching checksum) are highlighted by green, and invalid NMEA lines and non-NMEA data are highlighted by red. If **Status** displays “Waiting for data” and nothing appears in the **Data log**, it is necessary to check if correct COM-port is selected and setup properly, if the receiver is set up properly and properly connected to the computer. If the **Data log** displays arbitrary symbols highlighted with red, it is necessary to check port setup (speed, data and stop bits, parity, flow control) - these parameters must correspond to those of the receiver, as well as check the setup of the receiver itself.

The **Decoding errors** counter display total number of failures decoding NMEA messages received. One or two errors in the beginning of the session are acceptable. If the errors continue to appear from time to time during the established connection, they are probably caused by hardware problems on the way the signal passes from the receiver to the computer (bad contact, radio interference, bad cable or failing COM port, etc.). High rate of constantly emerging errors as well may be caused by incorrect receiver specification in the **Receiver model** field.

To save the setup, click **OK** or **Apply** buttons. To revert changes made, hold **Alt** key and click the **Revert** button appearing in the place of **Cancel** button. To close the dialog without saving changes, simply click **Cancel**.

### 15.5 Working with GPS

After the GPS receiver setup is complete, the connection is controlled by the following commands in the menu **Service | GPS** and corresponding buttons of the **GPS** toolbar:

<table>
<thead>
<tr>
<th><strong>Menu command</strong></th>
<th><strong>Toolbutton</strong></th>
<th><strong>Description</strong></th>
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<tbody>
<tr>
<td><strong>Activate</strong></td>
<td><img src="image" alt="Activate" /></td>
<td>Open/close connection with the receiver. The connection must be setup beforehand by the <strong>Setup</strong> command (see 15.4 Communication)</td>
</tr>
</tbody>
</table>
### Synchronize marker

Turn on/off moving the marker in the current position read from the GPS receiver (see 15.1 General description).

### Monitor

Open the **GPS monitor** window, see 15.6 GPS monitor.

### Setup

Setup the connection with the receiver, see 15.4 Communication setup.

---

**15.6 GPS monitor**

The **GPS monitor** window displays the data read from the GPS receiver. The toolbar of the window also duplicates the commands controlling the connection (see 15.5 Working with GPS). This window opens by the menu command Service | GPS | Monitor or by the corresponding GPS toolbar button.

![GPS Monitor Window](image)

Besides the toolbar, the window contains the following readings:

- **Color indicator State.** It may have the following colors:
  - **Gray** – the GPS receiver is not connected
  - **Red** – error communicating with the receiver or no satellite data fix available
  - **Green** – data stream from the receiver is being read without errors
- **Fix** – when the receiver is online, displays: «2D» when plane coordinates are available and «3D» if 3D coordinates are fixed. It is grayed out when the receiver is offline.
- **Satellites** – displays number of satellites participating in the fix (a minimum of 3 satellites is needed to obtain plane coordinates, and 4 - to obtain three-dimensional fix)
- **Latitude, Longitude** and **Height** display the WGS 84 latitude, longitude and height respectively
- **HPE (Horizontal Precision Estimation)** – estimated horizontal precision in meters
- **DOP (Delusion of Precision)** – estimation of the fix reliability based on the disposition of the satellites
- **Speed** – current absolute value of speed vector
- **Heading** – current direction of the speed vector

All the fields contain values directly obtained from the GPS receiver. Depending on the receiver model and setup, some of the fields may stay empty. When the receiver goes offline, the fields remain filled with the data last read. When the ingoing data stream is coming, the updated fields have white color, not updated - gray.
The detailed description of the meaning of the displayed values is given in the corresponding technical documentation on GPS and falls outside the scope of this Manual.

16. Hot keys

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<th>Arrow keys</th>
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<td>Panning</td>
<td>Marker moving</td>
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<tr>
<td>Alt Arrow keys</td>
<td>Shift</td>
<td>F6 On/off fixed marker mode</td>
</tr>
<tr>
<td>NumPad 1-4,6-9</td>
<td></td>
<td>PgUp/PgDn Moving marker along Z</td>
</tr>
<tr>
<td>Alt Left mouse button</td>
<td>Pan by mouse</td>
<td>Shift Left mouse button Selection by mouse</td>
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<table>
<thead>
<tr>
<th>Zoom</th>
<th>* Zoom in</th>
<th>/ Zoom out</th>
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<tbody>
<tr>
<td>/</td>
<td>Center by marker</td>
<td></td>
</tr>
<tr>
<td>Alt 1</td>
<td>Zoom 1:1 (100%)</td>
<td></td>
</tr>
<tr>
<td>Alt 2</td>
<td>Zoom in (200%)</td>
<td></td>
</tr>
<tr>
<td>Alt 3</td>
<td>Zoom in (300%)</td>
<td></td>
</tr>
<tr>
<td>Alt 4</td>
<td>Zoom in (400%)</td>
<td></td>
</tr>
<tr>
<td>Alt Enter</td>
<td>Fit in window</td>
<td></td>
</tr>
<tr>
<td>Ctrl+Alt Left mouse button</td>
<td>ZoomIn by zoom box</td>
<td></td>
</tr>
<tr>
<td>Ctrl+Alt+Shift Left mouse button</td>
<td>ZoomOut by zoom box</td>
<td></td>
</tr>
<tr>
<td>Ctrl+Alt Mouse wheel</td>
<td>Changing zoom</td>
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<table>
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<th>Marker for pre-regions editing</th>
<th>Insert Add or insert vertex</th>
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<tr>
<td>Enter</td>
<td>Move selected vertex by mouse</td>
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<tr>
<td>Delete</td>
<td>On/off snapping mode</td>
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<tr>
<td>Ctrl Mouse move</td>
<td>Join to polyline in vertex</td>
</tr>
<tr>
<td>V</td>
<td>Join to polyline in vertex</td>
</tr>
<tr>
<td>Shift V</td>
<td>Select vertex closest to marker</td>
</tr>
<tr>
<td>Shift L</td>
<td>Orthogonal mode (while the key is pressed)</td>
</tr>
<tr>
<td>Shift S</td>
<td>3D snapping to vertices, 2D snapping to vertices, 3D snapping to lines, 2D snapping to lines (while the key is pressed)</td>
</tr>
<tr>
<td>Ctrl A</td>
<td>PHOTOMOD AT</td>
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<tr>
<td>Ctrl R</td>
<td>PHOTOMOD Solver</td>
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<td>Ctrl S</td>
<td>PHOTOMOD StereoDraw</td>
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<tr>
<td>Ctrl M</td>
<td>PHOTOMOD Mosaic</td>
</tr>
<tr>
<td>Ctrl V</td>
<td>PHOTOMOD VectOr</td>
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</tbody>
</table>