



# MATCH-AT

## INPHO SOFTWARE

High throughput aerial triangulation with automated tie point selection, multi-ray point matching and bundle adjustment, GNSS and IMU support and calibration of camera and bore-sight misalignment. Processes frame sensors, satellite imagery and pushbroom data.

Precise aerial image triangulation with exceptional performance:

- ▶ Geo-reference blocks of aerial imagery based on the advanced and unique image processing algorithms for both frame and with MATCH-AT Pushbroom, line sensor data
- ▶ Fully automated processing even for large projects
- ▶ Processing is independent of flight geometry and supports completely arbitrary flight patterns
- ▶ Automatically extract tie points in frame images at optimal locations using multi-ray image matching
- ▶ Measure or verify control and tie points, guided by graphical block analysis
- ▶ Orient image blocks using proven bundle block adjustment and quality control tools
- ▶ Rigorous GNSS and IMU data support, including calibration of boresight misalignment and shift and drift corrections
- ▶ Due to its flexible data exchange capability MATCH-AT easily integrates into the workflow of any third-party photogrammetric system.

### Everything you need in one package

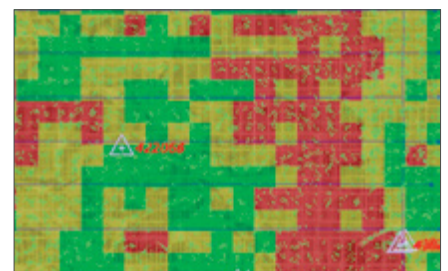
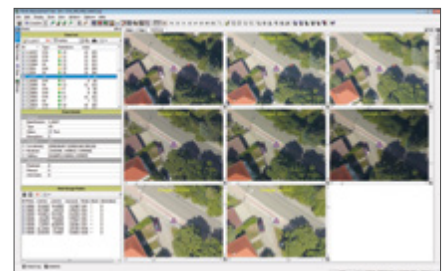
- ▶ Tie point measurement
- ▶ Robust bundle adjustment
- ▶ Thorough intuitive QA/QC
- ▶ Complete camera calibration
- ▶ Exports/Imports
- ▶ includes inBLOCK for most flexible parameters, correction strategies and analyzing capabilities

### Product Highlights

- ▶ Single, automatic process for point selection, point transfer and measurement, along with an integrated and robust bundle block adjustment requires minimum user interaction
- ▶ Support of any film or digital frame sensor, satellite data and pushbroom sensors (MATCH-AT pushbroom)
- ▶ No block size, shape or overlap limitations; tested with projects at 90/80 percent overlap and block sizes of up to 40000 images (20000 images in one sub-block)
- ▶ Tie points are automatically collected in image areas best contributing to the block strength and quality; Von Gruber positions can be used, or other patterns in case of rectangular image formats or special image overlap situations
- ▶ High precision tie point correlation (0.1 pixel) is achieved using an advanced combination of feature-based and least-squares matching, with multi-threading support
- ▶ Effective tie point matching also in poorly textured, as well as mountainous areas
- ▶ Strong internal tie point quality control achieved by performing robust bundle block adjustment in each level of the image pyramid
- ▶ Flexible weighting schemes for all types of observations
- ▶ Multi-phase blunder detection
- ▶ Internal & external reliability measures

## Key Features

- ▶ Fully automatic tie point matching and tie point transfer with a fully integrated robust bundle block adjustment allowing for iterative refinement of complex orientation tasks
- ▶ Multi-camera support with full calibration capability
- ▶ GNSS/IMU trajectory corrections
- ▶ Repeatable quality ensured by thorough, reliable and easy to understand graphical as well as statistical analysis
- ▶ Support for frame imagery, satellite imagery and pushbroom sensors (with MATCH-AT pushbroom)



## TECHNICAL SPECIFICATIONS

## FEATURES OVERVIEW

**Multi-camera support in one block and camera specific self-calibration**

- Self-calibration results are made available as a dense correction grid for further use in any subsequent applications
- Full camera calibration with inBLOCK camera calibration mode (focal length, principal point, distortion, non-squared pixels) including calibration report. Physical (5), Brown (16), Ebner (12) or 44 parameter distortion models.
- Powerful adjustment engine:
- Free block adjustment possible
- Flexible weighting schemes
- Sparse matrix technology
- Bandwidth minimization
- Reduced normal equations
- Fully automatic interior orientation for film cameras
- Project-wide photo display with correct topology, and auto image-selection for interactive, guided control point measurement.
- Multiple stereoscopic display for easiest stereoscopic manual point measurement
- Advanced sub-block handling
  - Sub-blocks enable easy administration, visualization and analysis of large blocks
  - Free block adjustment allow sub-blocks adjustment without control points
  - Sub-blocks as well as complete sub-projects can be merged
- GNSS data handling with shift and drift determination
- IMU data handling:
  - Preprocessed GNSS/IMU data from POS AV/POSEO by Applanix and AEROCtrl by IGI or similar
  - Attitude data are used as constraints in the integrated block adjustment
  - Bore-sight misalignment calibration (correction with up to 3rd polynom order)
- Calculation of ray intersections to check accuracy in specific stereo pairs
- Transform projects between different datums and projections, grid-based transformations, 7-parameters transformations and geoid application available
- Optionally the triangulation can be made in a local space rectangular coordinate system to avoid tensions caused by map projections
- Powerful intuitive graphical block analyzer:
  - Easy visual checking of large data sets
  - Visualizations: image footprints; overlaps; ground control and tie points; point and photo connections; residuals; error ellipses; geometric sector analysis for points and images; binning cell analysis for point density/connectivity; useful display filters, for example multi-strip connections and more; Statistical data tables directly linked to graphics
  - Internal and external reliability values for all observations and unknowns
  - Sensitivity analysis for undetectable gross errors, and their possible influence onto the block
- Specialized UAV/UAS mode for full automatic successful triangulation of challenging UAS projects
- Specialized satellite triangulation mode with automatic tie point matching and positioning refinement
- Smooth transfer of exterior orientation data to stereoplotters (e.g. Summit Evolution) and other photogrammetric applications, such as OrthoMaster or MATCH-T DSM
- High performance with multithreading

**MATCH-AT for pushbroom sensors**

- MATCH-AT Pushbroom supports ADS line sensors
- Processing supports completely arbitrary flight patterns, including: arbitrary directions (non-cardinal flights), overlaps, crossings and elevations – even turns and changes in elevation during ongoing acquisition
- The sophisticated math model includes simultaneous rigorous photogrammetric sensor modeling and advanced vehicle/platform dynamics modeling of IPAS or Applanix navigation data
- 3rd party compatibility is provided through generation of adjusted Leica GPro compatible SUP- and ODF-files

## BENEFITS

- Accurate and reliable results in just few seconds per image High degree of process automation
- Perfectly designed matching strategies lead to maximum ray connections for tie points

## VERSIONS

- MATCH-AT:
  - Geo-referencing of frame images
  - Unrestricted number of images
  - Camera Calibration available
  - Including inBLOCK
  - Satellite triangulation
- MATCH-AT Pushbroom:
  - Geo-referencing of pushbroom sensor data
  - Unrestricted number of images
- MATCH-AT Box:
  - Combines MATCH-AT with MATCH-AT Pushbroom
- MATCH-AT Lite:
  - Geo-referencing of frame images
  - Block size restricted to 250 images
  - Handling and merging of sub-blocks is not available
  - Multithreading is not available

## OPTIONS

- MATCH-AT pushbroom add-on: adds pushbroom adjustment capability to existing MATCH-AT software
- Monthly rental and upgrades for MATCH-AT versions available
- Maintenance (1st year included in software price) includes support and version updates
- Update of previous versions
- Upgrade from lite version
- Network licensing available

## SYSTEM REQUIREMENTS

- Multicore PC workstation ( 1 license supports up to 16 cores)
- 8 GB RAM
- High-capacity disk system
- Windows 7, 64 bit
- Special hardware for state of the art stereoscopic point measurement:
  - Stereo-capable graphics card(s) supporting OpenGL quad-buffered stereo (e.g. Nvidia quadro series)
  - Stereo viewing system
  - Optional color anaglyphs for systems without stereoscopic hardware

## SUPPORTED SENSOR TYPES

- Imaging sensors:
  - Analogue and digital frame sensors
  - Panchromatic or multichannel
  - ADS Pushbroom sensors (MATCH-AT pushbroom)
  - Thermal images
  - Satellite sensors (including SPOT 1-7, Plejades, Quickbird, IKONOS, ALOS, ASTER, CARTOSAT, IRS, GeoEye, Landsat, OrbView, RapidEye, WorldView, Resurs-P...)

## PERFORMANCE

- Suited for massive data volumes; tested with projects up to 40000 images
- About 10 seconds computation time per frame
- Theoretical accuracy about 0.1 pixel

## SUPPORTED FORMATS


- Supported image formats:
  - Georeferenced orthos: GeoTIFF, TiffWorld (tfw), ADS+tif/tfw
  - TIFF, JPG, BigTiff
  - JPEG2000, TIFFjpeg
  - EXIF
  - 8/12/16 bit
- Height model / morphology data formats
  - Grid-operations:
    - ◊ \*dtm \*.rdh \*.bil \*.fit \*.tol \*.grd \*.tif \*.tiff \*.smti \*.tpx.shp, BIL, BWNP, BXYZ, DTM, DXF, DXF\_TIN, FLT, GRD, LAS, LASZip, SHP\_TIN, TIFF16, TIFF32, VRML, VRML\_TIN, WNP, XYZ
  - Point-cloud operations:
    - ◊ LAS, LASZip, XYZ, BXYZ

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