

Leica Photogrammetry Suite Product Description





Leica Photogrammetry Suite

Overview

Leica Photogrammetry Suite (LPS) is a versatile software product for digital photogrammetric workstations, providing accurate and production oriented photogrammetric tools for a broad range of geospatial imaging applications. It allows users to work with imagery from a wide variety of sources and formats including black and white, color or multispectral with up to 16 bits per band. LPS also generates the whole range of deliverables photogrammetrists demand, from triangulated imagery and digital terrain models to line-of-sight analyses. These processes are facilitated by a wide choice of formats for imagery, ground control, orientation and GPS data, vector data and processed imagery. Projects can be completed in any of hundreds of coordinate systems and map projections.

The key to the ease of use and productivity of LPS is a tight focus on workflow through the unique Workflow Toolbar. The toolbar guides users through projects from beginning to end. Users can easily monitor the progress of their projects, whether they are completed step-by-step or with extensive use of LPS' batch processing functionality.

The breadth and richness of LPS stems from the photogrammetric, remote sensing, and geospatial imaging software developed by industry leaders now part of Leica Geosystems Geospatial Imaging. The result is a suite of easy-to-use, highly accurate software tools supported by experienced engineers and technical support personnel in over 100 countries.

Key Features

LPS works with both stereo and monoscopic hardware configurations on Microsoft Windows XP and Microsoft Windows 2000 platforms. Full 3D stereo imagery can be viewed using either passive polarized or active LCD stereoscopic viewing systems.

LPS is a modular product. The core module is feature-rich and suitable for many standard applications. Modules that provide more advanced functionality can be added seamlessly. This emphasis on modularization reduces cost and also facilitates complex work environments where workstations with different levels of functionality can share imagery and data in an optimum way. These workflows are additionally enhanced by LPS' ability to use control, orientation and vector data with analogue and analytical workstations.

LPS Architecture

The modular architecture of LPS allows it to be scaled to accommodate a variety of photogrammetric and GIS workflows. Additional software products, shown in gray in the following illustration, can be added to LPS configurations to further extend the software's functionality. From production mapping to an all-in-one desktop mapping system, photogrammetrists, engineers and GIS professionals can meet all of their photogrammetry needs and requirements within the LPS environment.

LPS Modules

LPS Core

The rich, comprehensive nature of LPS is dependent on the extensive Core module, a prerequisite for almost all of the other modules.

Project setup and management

- Automated management of key data assets including images, terrain files and feature files
- Data assets can be:
 - Selected and added into the project all at one time
 - Viewed graphically in their georeferenced positions
 - Taken off-line from the project/block and then easily reattached for further processing
- Input and output of ground control, GPS data, triangulation data, imagery, vector data, scanned paper maps and terrain files in a variety of popular formats
- Powerful CellArray™ table to manipulate data and track progress
- Key operator preferences are stored between sessions

Data input and export

LPS supports a wide range of ground control data, GPS data, triangulation data, vector data, scanned paper maps, digital orthophotos and terrain files in a variety of popular formats. Grayscale and color raster image formats are supported, including 8 to 16 bits per band per pixel and virtually unlimited numbers of bands per image. See the chart at the end of this document for a complete list of supported raster image formats and sensor models.

Coordinate systems

LPS supports a wide range of horizontal and vertical datums, coordinate systems and map projections including user-defined systems and coordinate conversions.

Tracking devices

LPS supports several XYZ controls.

- TopoMouse 3D Hand Controller
- System Mouse
- Immersion Device
- ITAC Mouse-Trak Trackball
- Stealth 3D (Immersion)
- Hand Wheels (EK2000)

Image Viewing

In addition to the stereo-viewing technology available with LPS Stereo, LPS offers two choices for viewer display. The IMAGINE Geospatial Light Table (GLT) or the classic IMAGINE Viewer. Both options allow users to:

- Drag and drop images into the viewer
- Display multiple vector and raster layers
- Display and project multiple images in a single view
- Load and view entire blocks of images as virtual mosaic
- View any combination of sensor types
- Apply Dynamic Range Adjustment
- Open multiple views and link them
- Continuously roam and zoom
- Reproject on-the-fly
- Use subpixel cursor positioning and measurement
- Apply image enhancements:
 - Rotation
 - Brightness and contrast
 - Histogram manipulations
 - Filtering
- Plus a palette of more sophisticated image processing tools
- Read out ground and image coordinates, 2D and 3D measurements
 - Distance, azimuth, slope
 - Area of polygon
 - Length of polyline
 - Build image pyramid (minification)
- Use multithreading when multiple processors are available

Interior orientation

LPS allows users to define the internal geometry of imagery using measured fiducial marks.

- Both automatic and semi-automatic processes available, with interactive quality control
- RMS error represented in pixels and microns
- Flexible color code assignments for fiducial marks
- Automatically drives to estimated fiducial mark positions

Camera definitions

Definitions for calibrated cameras and lenses can be defined and saved within LPS. Camera options include:

- Camera name and description
- Focal length
- Principal point offset in the x and y direction
- Number of fiducial marks and their calibrated positions
- Pixel size for digital and video cameras
- Lens distortion

Automatic tie point measurement

LPS can automatically determine the corresponding image positions of ground points appearing on multiple overlapping images. Functionality includes:

- Point pattern selected by operator
- Adaptive strategy cross-correlation with feature-based matching and shadow avoidance
- Automatic transfer of points between images
- Simultaneous processing of imagery collected within normal and crossing flight lines
- Graphical view of tie point patterns
- Shadow avoidance algorithm

Classic Point Measurement

LPS Core allows the user to measure monoscopic and split-view measurements of ground points manually.

- The CellArray is used to display and edit:
 - Point IDs and description
 - GCP, tie point and check point coordinates and their residuals
 - Image coordinates and their residuals
 - GCP type (full, horizontal, vertical)
 - Point usage (tie, check or GCP)
- Imagery within a strip can be toggled for display during point measurement
- Automatic drive to estimated x and y image locations of GCP positions
- Undo GCP, tie point or check point measurements and edits

Stereo Point Measurement

LPS Core (with LPS Stereo for stereo viewing capabilities) allows the user to measure stereo, split-view and monoscopic measurements of ground points automatically and manually.

Additional capabilities beyond the Manual Point Measurement tool include:

- Stereo viewing capability
- Input device support with button mapping capability
- Automatic point correlation functionality
- Support for multiple viewers, which is beneficial for measuring multi-ray points
- Map display for image selection and loading, as well as point distribution review
- Ability to drive to next and previous points
- Various image selection options
- Image adjustment capabilities, with Dynamic Range Adjustment

Triangulation

LPS Core helps users define the relationship between the imagery contained in the project, the sensor model and the ground. Once images have been triangulated, additional data processing such as DTM extraction, terrain editing, orthorectification and feature collection can be performed.

Capabilities include:

- Block definition
- Support of post-processed airborne GPS to define sensor position
- Support of existing aerial triangulation results in the form of exterior orientation from analog, analytical and digital photogrammetric workstations
- Graphical display to enable users to identify and resolve blunders including image footprints and residuals
- Bundle adjustment of multiple images from one or more sensors
 - Fully weighted least squares solution with GPS
 - Automatic blunder detection.
- Statistical models provided for weight constraint of observations include:
 - x and y image coordinates
 - X, Y and Z ground control points
 - Exterior orientation parameters
 - Interior orientation parameters
 - Additional parameters accounting for systematic errors
- Five additional parameter (AP) models provided for determining the extent of systematic error associated with the photogrammetric network of observations and the sensor models used in the project
- Self-calibration techniques used to determine focal length, principal point offset in the x and y direction
- Triangulation can be processed without ground control if the exterior orientation parameters are available
- Pseudo free-network triangulation can be processed by fixing seven parameters from either exterior orientation or ground control
- Two automated error-checking models are provided for identifying and removing erroneous observations from the aerial triangulation process
- A summary report is provided for the display of global solution quality
- An advanced triangulation report provides a comprehensive output list of the adjusted and estimated parameters and their accuracies, precisions and photo-coordinate residuals

Orthorectification

LPS can remove the scale variation inherent in imagery caused by sensor orientation, topographic relief displacement and systematic errors associated with imagery, resulting in planimetrically correct images representing ground objects in their true, 'real world' X and Y positions. Orthorectified imagery has become accepted as the ideal reference image backdrop necessary for the creation and maintenance of geographic information contained within a GIS database.

- Simultaneous processing and parameterizing of multiple orthos in one solution
- Single orthos can be generated independently
- User-defined X and Y ground resolution
- Orthorectification from a constant elevation value or using elevation sources in various formats including IMAGINE Raster, TerraModel TIN, SOCET SET TIN, 3D Shapefile, and ASCII text files
- Ability to trim the outer extents of the output ortho
- Support for batch processing
- Ortho resampling options include Nearest Neighbor, Bilinear Interpolation and Cubic Convolution
- Ortho-calibration techniques eliminate the need to create new image files
- Unique map projection and units can be assigned to each output ortho
- Oriented image creation for input into Stereo Analyst® for ArcGIS

Mosaicking

Mosaics can be generated from multiple images in LPS using a variety of options.

- Make a mosaic directly from raw images or from orthos
- Directly ingest a block file allowing for the simultaneous processing of color balancing, orthorectification and mosaicking
- Select area, pixel size and algorithms
- Select input images individually, by entire directory or by file list
- Input images may be of differing map projections
- Select elevation sources in any supported raster format
- Define mosaic area by entire image or area of interest (AOI)
- Automatically crop input images to avoid fiducial marks
- Mosaic images that are fully georeferenced or only relatively positioned
- Automatically color balance within and between images
 - o Manual or automated
 - o Define abnormal areas for exclusion from processing
 - o Surface fitting and dodging
 - o Preview color balancing effects
 - o Option to use existing lookup tables

- Determine cutlines automatically
 - o Weighted cutline generation capability
 - o User can edit cutlines
 - o Cutlines can be radiometrically feathered
- Create rotated orthomosaics
- Graphical interface to view outlines, overlap areas and cutlines
- Support for batch and command-line processing
- Output options:
 - o Union of all inputs to a single file
 - o AOI to a single file
 - o Multiple AOIs to multiple files
 - o Use Map Series files to output multiple files on user-defined grid or mapsheet pattern
 - o Output coordinate systems and map projections may be different than project
 - o Outputs in supported image formats

Map composition

Create digital image maps with LPS.

- Maps can be created from raw images, orthophotos or mosaics
- Graphical overlays and marginalia ("collar") such as north arrow, grid lines and labeling
- Annotation layers
- Output to variety of printers, plotters and popular file formats

3D Surfacing

Use this tool to create and manipulate terrain datasets.

- Read in ASCII, vector and breakline data and output terrain files in various formats
- Merge breaklines and terrain files

IMAGINE Advantage®

LPS Core includes the full functionality of IMAGINE Advantage. Please see the product descriptions for IMAGINE Essentials® and IMAGINE Advantage for more information.

LPS Stereo

LPS Stereo allows 3D stereoscopic viewing of imagery in several modes. The stereo display makes optimal use of recommended graphics cards.

- Moving cursor/fix image and fixed cursor/moving image
- Smooth, seamless roam in moving image mode
- Active and passive three-dimensional viewing eyewear supported
- Single or dual screens supported
- Drag and drop images into viewer
- Fast graphics rendering
- On-the-fly epipolar rectification for comfortable viewing when required

- Automatic Z placement of cursor from a terrain model or image matching
- Multiple stereo views can be opened simultaneously
- Each view can be monoscopic, stereo, split-screen or tri-view (stereo and split-screen)
- Cursor displayed in every image
- Continuous zoom in and out, as well as discrete steps such as 1:1 and 2:1
- On-the-fly resampling for subpixel cursor positioning and measurement
- Image enhancements including rotation, brightness, contrast, and dynamic range adjustment
- Multi-threaded processing when multiple processors are available

LPS ORIMA

LPS ORIMA provides production photogrammetry software for block triangulation and analysis.

- Self-calibrating bundle adjustment for frame and ADS40 imagery
- Economic data organization to manage very large numbers of images
- Multiple image display during point measurement
- Measuring speed is not reduced as projects increase in size
- Specialized math model for ADS40
- Allows for combined triangulation of ADS40 and frame imagery
- Highly automated statistical techniques for blunder detection and elimination and full error propagation
- Fully automatic point measurement and ground control point transfer
- Semi-automatic point measurement in stereo
- Sequential adjustment as points are measured allows easier measurement and errors to be detected early
- Interactive graphical tools for analysis of blocks and identification and elimination of blunders or weak areas, with error ellipses, error rectangles, ray intersection geometry and image area identification for point-and-click supervised re-measurement
- Graphical output can be directed to printer or plotter
- Complete numerical reports
- Rigorous weighting and incorporation of GPS, with or without drift parameters and IMU misalignment
- Flexible input formats from GPS and IMU data
- Rigorous transformation from ground to sensor including map projections or use of geographic coordinates
- Context-sensitive help and wizards
- Available in multiple languages
- Several versions with different functionality are available to suit user requirements

LPS Automated Terrain Extraction (ATE)

LPS supports fully automatic generation of terrain from two or more images.

- A production-oriented, linear workflow
 - Define general DTM project properties including map projection and file format
 - Select image pairs of interest
 - Define areas for DTM
 - Define exclude areas
 - Input information to calculate DTM accuracy
 - Perform automated DTM extraction
- Automatically extract, subset and mosaic individual DTMs for an entire project area, encompassing hundreds of images with one click
- Cross-correlation and feature-based matching with adaptive strategy parameters
- DTM boundary is determined automatically from images or can be user-defined
- Support for aerial frame, Leica ADS40, digital, video and non-metric cameras, as well as satellite sensors (SPOT, IKONOS)
- Clip percentage may be specified on input images to avoid fiducial marks
- Scaleable user interface that can be customized for users ranging from entry-level GIS professionals to production mapping scientists
- Support for seed data (block control points, tie points, and external terrain models) for improving the correlation process
- Region growing tools automatically extract geographic regions of inclusion or exclusion or use existing ESRI Shapefiles, ARC SDE Vector Layers, ArcCoverage files or ERDAS AOIs
- Customized DTM extraction strategy parameters
 - Adaptive modification of strategy parameters is supported
 - Strategy parameters include:
 - Search area
 - Correlation size
 - Coefficient limit
 - Topographic relief type
 - Land cover object type
- Embedded quality assurance, quality control and accuracy reporting tools
- Quality checks to control points, check points, tie points, text files or other DTMs
- Accuracy report for each DTM containing statistical accuracy information such as RMSE, NIMA CE 90 and LE 90 calculations, mean error, global error, processing time statistics and general DTM extraction statistical output

- Error image for each DTM extracted, indicating geographic regions with excellent, good, fair, poor and interpolated DTM output
- Extracted DTMs can be output in ERDAS Raster format, 3D Shapefiles, TerraModel TINs, SOCET SET Grids or TINs, or ASCII files
- Use the 3D Surfacing Tool from LPS Core to provide merging of terrain and support for MicroStation DGN files and breaklines
- Support for batch processing

LPS Terrain Editor (TE)

TE provides extensive, powerful tools for editing raster or TIN DTMs with dynamic updating of graphics.

- Display terrain graphics superimposed on stereo imagery for editing and QA purposes
 - o Terrain displayed as points, lines, TIN (mesh) or contours
 - o More than one representation can be displayed simultaneously
 - o User selectable display options such as color, weight, size, and style
- Ability to add, delete or modify terrain using tools operating on points, lines or selection areas
- Area tools such as smooth, thin, bias, set to constant, fit to surface, interpolate
- Geomorphic editing tools for GRIDs
- Options for setting elevations in the area using current cursor elevation, area boundary, points inside or points outside
- Image display settings including fixed image, fixed cursor, continuous roam, contrast and brightness, stereo, mono
- Support for smooth contours
- Contour export options
- Breakline import and export capability
- Motion devices such as TopoMouse™ used for interactive cursor control button actions can be set and reviewed interactively
- Multiple undo and redo
- User defined thresholds for parameters such as snap distance
- Works with a variety of terrain formats including:
 - o Leica Terrain Format
 - o TerraModel TIN
 - o IMAGINE Raster
 - o Imported formats including:
 - Terrain pyramid file support with Leica Terrain Format
 - USGS Spatial Data Transfer Standard (SDTS)
 - NIMA Digital Terrain Elevation Data (DTED)

PRO600

LPS PRO600 is a sophisticated package for interactive feature collection and editing in the MicroStation GeoGraphics environment. It includes:

- Cartographic presentation tools such as line patterning, polygon hatching, symbology, contour annotation, slope hachure and manuscript grid placement
- Extensive feature coding capabilities
 - o Up to 8 codes per feature
 - o Tools to add/remove codes
 - o Selection set creation by feature code
- Display graphics in MicroStation views as well as LPS stereo image view
 - o 3D, bi-directional driver between MicroStation and stereo image view, cursor moves and graphics display in all views simultaneously
 - o Real-time input of XYZ coordinates to MicroStation
 - o Automatic color matching to MicroStation color definitions
 - o Rotate MicroStation views to kappa rotation of stereo view
- Collection modes and tools to enhance productivity
 - o Seven point-wise modes: Symbols, Lines, Strings, Curves, Arcs, Squares and Shapes (polygons)
 - o Monotonic mode for uphill or downhill integrity
 - o Single-shot symbol placement
 - o Spot elevation with text
 - o Multi-component feature collection, align shapes to other features
- Parallel line generation with up to 20 parallel lines simultaneously
 - o Digitized offsets re-used from one feature to next
 - o Offset adjustable while collecting feature
 - o Arc generation and clean joints around sharp corners and complex features
 - o Add parallel lines to existing features
- Button mapping using input devices such as TopoMouse, Immersion mouse or system mouse
 - o More than 100 button actions to choose from
 - o Function keys can also be mapped for an even greater number of actions
- Automatic periodic design file backup
- Undo and redo
- Ground control point utility allows plot of ground control points as annotated symbols
 - o Drive to ground control points
 - o Reads ORIMA, SOCET SET and plain text ground control point files
- Data editing including contour rounding, centerline generation
 - o Remove or resymbolize data behind text or shapes
 - o Square and align
 - o Line thinning

Leica MosaicPro

Leica MosaicPro improves the seam editing portion of mosaicking as well as offering additional radiometric adjustment capabilities. This module offers significant improvements in functionality for Mosaic Tool users. Leica MosaicPro is especially useful for high volume production users who need an efficient means of editing seams for large projects that may involve hundreds of images.

- Visualize the output mosaic with ease using polygonal seams that replace cutlines
- Perform seam editing in the new embedded viewer
- Update seams with one easy-to-use editing tool
- Display input images within the embedded viewer
- In the embedded viewer, input image boundaries are immediately updated when a seam edit is performed
- Easy options allow users to control which images are displayed within the embedded viewer
- A preview option is available for visualizing seam feathering, smoothing, radiometric adjustments and output GSD changes for a user-defined area
- All tools are now available within a single toolbar instead of three separate modes
- Image footprints are displayed in the embedded viewer and can be turned off and on easily
- User preferences and default settings are updated and optimized
- Global Balancing algorithm added for achieving optimal radiometric adjustment results
- View reference seam polygons for working on geographically adjacent projects

Companion Software Products

ImageEqualizer

ImageEqualizer is a useful tool for correcting and enhancing the images used in LPS.

- Perform balancing and dodging on single or multiple images
- Remove hot spots, vignetting and variations
- Interactive previewing capabilities

Stereo Analyst® for ArcGIS

Stereo Analyst for ArcGIS provides another option for 3D feature data collection in LPS. It allows for truly 3D feature collection and editing within the ArcGIS framework. It is the first photogrammetric product entirely built on a GIS.

- Transforms the visual contents of an image directly into the Geodatabase
- Supports direct revision and update of feature data in the Geodatabase
- Supports photogrammetric data derived from LPS and SOCET SET (aerial triangulation results)
- Supports Space Imaging and DigitalGlobe imagery
- Automatically transforms existing datasets and databases to 3D
- Supports multiple ergonomic digitizing devices (Mouse-Trak, TopoMouse, Immersion)
- Works with ArcView, ArcEditor or ArcInfo (Version 8.3)

Supported Raster Image Formats

- Arc/Info and Space Imaging
 - BIP
 - BIL
 - BSQ
- ASTER EOS HDF
- AVHRR
- AVIRIS
- BMP
- CADRG (Compressed Arc Digitized Raster Graphics)
- CIB (Controlled Image Base)
- Compressed files including:
 - JPEG
 - LZW
 - Packbits
 - RLE
- DOQ (USGS Digital Ortho Quads)
- DPPDB
- ENVI
- ER Mapper
- GeoTIFF
- GeoJP2
- GIF
- IKONOS
- IMAGINE Raster
- Intergraph CCITT Group 4 and COT
- JFIF (JPEG)
- JP2
- LANDSAT and LANDSAT-7
- MrSID
- MSS LANDSAT
- NASDA CEOS
- NITF 2.0 and 2.1
- PCIDSK
- PCX
- PNG
- RAW
- RADARSAT
- RPF
- SDE Raster
- SOCET SET® support file
- SPOT
 - CAP/SPIM
 - CCRS
 - DIMAP
 - Fast Format
 - GeoSPOT
 - NASDA CAP
 - SICORP MetroView
 - SPOT5
- SeaWiFS HDF
 - L1b
 - L2b (Orbview)
- Sun Raster
- TIFF
- TM LANDSAT Fast and Standard Formats
 - ACRES
 - EOSAT
 - ESA
 - IRS
 - LANDSAT-7
 - RADARSAT
 - Vitec
 - View (.vue)

Supported Sensor Model Formats

- ADS40 from Leica Geosystems
- ASTER rigorous
- DPPDB RPC
- EROS A and B
- Frame Camera
- Non-Metric Camera
- Digital Camera
- Video Camera (Videography)
- IKONOS RPC
- QuickBird rigorous and RPC
- SPOT 1-4
- SPOT 5 rigorous
- ALOS PRISM rigorous and RPC
- WORLDVIEW-1 rigorous and RPC
- GEOEYE-1/OrbView rigorous and RPC
- THEOS1 rigorous
- FORMOSAT2 rigorous
- Generic Pushbroom
- NITF RPC
- RESOURCESAT RPC

Leica Geosystems Geospatial Imaging offers a broad range of geospatial information technology, delivering the most comprehensive solutions in image exploitation, processing, visualization and data management. Organizations use this information for decision-making processes throughout the enterprise via web-based, mobile and desktop clients.

With Open Geospatial Consortium (OGC) and International Organization for Standardization (ISO) interoperability, Leica Geosystems develops solutions with the most advanced service-oriented platform available. These solutions empower users, making systems more flexible and accessible, therefore driving ROI for the enterprise.

The expert in geospatial imaging, Leica Geosystems facilitates the efficient capture of data, referencing of imagery, measurement and analysis of 3D referenced information. Providing robust image compression techniques, Leica Geosystems offers the most efficient delivery of imagery over the Internet or inside an organization.

With a rich history, Leica Geosystems continues to lead the industry, meeting customers' needs in today's enterprise environment. Those who use Leica Geosystems products every day trust them for their precision, seamless integration, interoperability and superior customer support. Geospatial solutions from Leica Geosystems - **when it has to be right.**

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- when it has to be **right**

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