



# IApioneer Technical Specifications

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## INTRODUCTION

Today's geospatial production workflows require accurate image exploitation as either the basis for further processing, or as an end in and of itself. Historically, the tools available required heavy training, laborious processing, and high costs...until now.

IApioneer offers a high level of image exploitation capability at the right cost. Developed under the SBIR program, IApioneer is a license-free (no-cost) tool for Federal Agencies to use for image exploitation and product generation. IApioneer provides the standard tools for imagery viewing and annotation, as well as advanced production support for such processes as: large-scale orthomosaic generation, elevation model creation and editing, and 3D site model generation from imagery. IApioneer also interfaces with the Common Ground Positioning (CGS) libraries – the DoD standard for precision point mensuration.

This technical specification document outlines the great tools and functionality available in IApioneer.

## IAPIONEER ENVIRONMENT

IApioneer contains all the tools and functionality necessary to view geospatial data, and exploit geospatial imagery by extracting 3D features, generating large scale orthomosaics, developing elevation models, and more. The IApioneer environment is comprised of six sections:

- Backstage
- Ribbon
- Left Viewer
- Right Viewer
- Image Gallery
- Data Layer Manager

### BACKSTAGE

Data ingestion, application settings, and support information are accessed through the Backstage, which can be accessed from the File tab of the Ribbon.

- **Save Session** – saves session file to a specific destination, overwriting existing files
- **Save Session As** – saves session file to a new destination
- **Open Session** – accesses existing session file
- **Close Session** – clears the current session and starts a new one
- **Load Data** – ingest geospatial data
- **Session** – data management pane showing the current session's contents
- **Help** – provides support information and links, as well as licensing information
- **Batch Aerial Workflow** – walks you through the process of configuring sensor models for multiple aerial images at once
- **Settings** – lets you customize the appearance of certain features and status messages
- **Exit** – exits 3D FeatureXtract

## SESSION PANEL

The Session panel contains information about all the files loaded in the current session. Each file is listed here, sorted by data category: Image, DEM, Vector, Tie Point, or Annotation.

New Vector Layers can be added to the session by clicking the **[Add Vector Layer]** button.

Right-clicking on an icon in the Session panel opens a context menu that lets you save data relating to the file, export the data in the file, or access utility functions such as reprojection, cropping, or accessing data properties.

For each data type, there is a context menu that contains the following options.

### IMAGES

- **Open in Left Window** – opens the image in the Left Viewer
- **Open in Right Window** – opens the image in the Right Viewer
- **Save Metadata** – saves the sensor model and other metadata associated with the image in the corresponding \*.omd file
- **Crop, Resample, and Reproject** – creates a copy of the image with specified cropping, resampling, and reprojection parameters
- **Data Conversion** – converts the data type of the image between number formats (Byte, Short, Unsigned Short, Int, Unsigned Int, Float, Double)
- **Export** – saves a copy of the image as a new file, and potentially a new file type as well

- **Properties** – lets you access the properties for the selected layer, including:
  - **General tab** – displays information about the image name, type, size, and geospatial coordinates
  - **Metadata tab** – displays tag information from TIFF or NITF files
  - **Band Info tab** – displays histogram information for the image bands
  - **Sensor Model tab** – provides user-settable information about the image sensor model
- **Remove Selected** – removes the selected image from the session

### DEMs

- **Open in Left Window** – opens the image in the Left Viewer
- **Open in Right Window** – opens the image in the Right Viewer
- **Save Metadata** – saves the sensor model and other metadata associated with the image in the corresponding \*.omd file
- **Crop, Resample, and Reproject** – creates a copy of the image with specified cropping, resampling, and reprojection parameters
- **Data Conversion** – converts the data type of the image between number formats (Byte, Short, Unsigned Short, Int, Unsigned Int, Float, Double)
- **Export** – saves a copy of the image as a new file, and potentially a new file type as well
- **Properties** – lets you access the properties for the selected layer, including:

- General tab – displays information about the image name, type, size, and geospatial coordinates
- Metadata tab – displays tag information from TIFF or NITF files
- Band Info tab – displays histogram information for the image bands
- Sensor Model tab – provides user-settable information about the image sensor model
- **Remove Selected** – removes the selected image from the session
- **Get Fingerprint** – gets the unique fingerprint for your hardware for the licensing process
- **Provide License** – allows you to provide a license key to activate your 3D FeatureXtract software

## RIBBON

### HOME TAB

#### DATA GROUP

- **Layer Manager** – shows/hides the Data Layer Manager
- **Hide All** – hides all data layers
- **Open Stereo** – opens the stereo viewer for a specified pair of images

#### DISPLAY GROUP

The options in the display group control how imagery is viewed in the active window only.

- **Histogram** – opens the color curves dialog for histogram manipulation
- **Brightness** – allows you to choose between pre-defined brightness options, or a custom value based on a slider
- **Contrast** – allows you to choose between pre-defined contrast options, or a custom value based on a slider
- **Filter** – allows you to select from a number of pre-defined image filters
- **North Arrow** – turns the North arrow on and off
- **Image Overview** – launches a thumbnail overview of the entire image, with the current viewpoint indicated by a bounding box

### VECTORS

- **Save Data** – saves the vector layer with any changes
- **Save Data As** – saves the vector layer with any changes as a new file
- **Export** – saves an edited vector layer as a new file, possibly as a new file type
- **Spatial Referencing Configuration** – lets you view and change the vector layer's spatial referencing system
- **Remove Selected** – removes the selected vector layer from the session

### HELP PANEL

The Help panel provides access to support information, application settings, and licensing.

- **Product Information** – provides online resources about 3D FeatureXtract and the other titles in the IAVO product line
- **Online Support** – provides links to online support information
- **Settings** – allows you to customize the appearance of certain features and status messages
- **Licensing** – contains information about your current license

- **Gridlines** – overlays the image with a geographic grid

#### CAMERA GROUP

- **Zoom** – choose between a pre-defined set of zoom ratios
- **Zoom 1:1** – zoom to 100%
- **View Extents** – sets zoom ratio to fit image into viewer
- **Zoom to Box** – zooms to fit a user-specified box into the viewer
- **Jump to Location** – center viewer on user-specified geospatial or pixel location
- **Camera Lock** – geospatially links viewers
- **Pan Mode** – sets the viewer mouse movement to Pan Mode
- **Roam Mode** – sets the viewer mouse movement to Roam Mode

#### ROTATION GROUP

- **Compass** – freeform rotation about the center of the viewer
- **Image Up** – rotates image to align the image columns to the columns of the viewer
- **North Up** – rotates the image so that the direction to North is aligned with the columns of the viewer
- **Z Up** – rotates the image so that the local z-axis is aligned with the columns of the viewer
- **Rotate 180** – rotates the image 180 degrees
- **Left 90** – rotates the image anticlockwise 90 degrees
- **Right 90** – rotates the image clockwise 90 degrees

#### IMAGE GROUP

- **Region of Interest** – show/hide the current ROI
- **Set Region of Interest** – allows you to specify a new region of interest
- **Image Chip** – launches the Crop, Resample, and Reproject dialog
- **Chip from ROI** – pre-sets the chipping dialog with the ROI bounds
- **Full Screen Chip** – pre-sets the chipping dialog with the viewer extents
- **Screen Capture** – saves the active viewer contents to a flat image file
- **Cursor Information** – provides geographic and pixel information for the current cursor position

#### SOURCE DEM GROUP

The Source DEM is the elevation source used for cursor tracking, camera linking, and building extrusion. If there is a DEM loaded into the session, you can select it from the pull-down box in the Source DEM group to specify that you wish to use that DEM for these activities.

There are two other potential elevation sources that you can use in your production workflows. The first is a low-resolution, worldwide DEM distributed with 3D FeatureXtract. Alternatively, if you have access to DTED, you can specify the directory structure in the Terrain settings.

The priorities for elevation source are:

1. User-specified DEM
2. DTED directories
3. Default low-resolution DEM

## ANALYSIS TAB

### INSERT GROUP

The Insert group contains the tools to markup the imagery with standard annotation tools.

- **Shapes>Ellipse** – allows the user to draw an ellipse by dragging out the bounding box (viewer oriented)
- **Shapes>Point** – places a circles point designator at the clicked location
- **Shapes>Polygon** – allows the user to draw a closed polygon
- **Shapes>Polyline** – allows the user to draw a multi-segment line
- **Shapes>Rectangle** – allows the user to draw a viewer oriented rectangle
- **Shapes>Text Box** – allows the user to place an editable text box
- **Shapes>Point Marker** – allows the user to place a point marker with an editable text box callout
- **Shapes>Target Circles** – allows the user to place a point marker, with concentric distance rings and an editable text box callout
- **Shapes>North Arrow** – allows the user to place a north arrow
- **Clip Art** – launches a dialog that allows the user to navigate Mil-STD-2525B graphics and drag/drop graphics into the viewer

### INSPECT/MEASURE GROUP

The Inspect/Measure group contains tools for image-based measurement.

- **Separation Angle** – Allows the user to draw and measure angles

- **Length** – Allows the user to draw and measure horizontal distances

## FEATUREXTRACT TAB

### CREATION GROUP

The Creation group contains the tools to generate new 3D features in FeatureXtract. Creation modes are persistent. Once a Creation mode has been set, all new features will be of that same type until the Creation mode is changed.

- **Polygon>Draw Polygon** – sets the creation mode polygons
- **Polygon>Draw Box** – sets the creation mode to boxes
- **Point** – sets the creation mode to points
- **Line** – sets the creation mode to polylines
- **Circle** – sets the creation mode to circles

### MANIPULATION GROUP

The Manipulation group contains the tools to manipulate features in FeatureXtract. Manipulation modes are persistent. Once a Manipulation mode has been set, all feature movements will be of that same type until the Creation mode is changed.

- **Move Epipolar** – restricts the movement of features to the epipolar lines defined by the two cameras
- **Move Z-axis** – restricts the movement of features to the local z-axis



- **Move Freehand** – restricts the movement of features to the local x-y plane
- **Rotate** – rotates the feature about the local z-axis

### DETAILING GROUP

The Detailing group contains the tools to augment base features with additional geometry, to rapidly generate 3D features.

- **Extrude Polygon(s)** – extrudes the selected polygons to the underlying elevation source
- **Loft Feature** – combines polygons, lines, and points to rapidly create conical geometries
- **Build Roof>Pitched** – parametrically create a pitched roof
- **Build Roof>Cylindrical** – parametrically create a cylindrical (barracks, Quonset) roof
- **Build Roof>Dome** – parametrically create a dome
- **Reverse Face** – reverse the normal of the selected polygon

## OMNIDEM TAB

### MISCELLANEOUS GROUP

The Miscellaneous group contains the tools to generate and edit digital elevation models (DEMs) from imagery.

- **DEM Fusion** – combines multiple DEMS into a single product
- **DEM to Vector** – Converts a raster DEM to a 3D vector point cloud

- **Epipolar Rectification** – performs epipolar rectification on a pair of images
- **Area Correlation** – generates a DEM from a pair of images (rectified or unrectified)
- **Vector Interpolation** – performs interpolation on a point cloud of 3D coordinates to generate a regularly sampled DEM

## GEOGENESIS TAB

### IMAGE CORRECTION GROUP

The Image Correction group contains the tools to register imagery to a common reference and update the image sensor models.

- **Image Update** – performs a quick 1-, 2-, or 3-point update between a source image and a reference
- **Bundle Adjustment** – performs block bundle adjustment on a set of images with a specified tie point set
- **Data Warping** – performs non-linear rubber sheeting of image or vector data to a reference using a specified tie point set

### MISCELLANEOUS GROUP

The Miscellaneous group contains production tools to work with multi- and single-band imagery in support of large scale orthomosaic products.

- **Automatic Tie Point Extraction** – automatically finds tie points between overlapping images

- **Resection** – computes frame camera sensor model parameters from a set of ground points
- **Grayscale Conversion** – converts a multi-band image into a single-band image
- **Pan Sharpening** – uses a high-resolution panchromatic image and a lower-resolution multispectral image to generate a high resolution multispectral image
- **Orthorectification** – removes terrain distortions from raw imagery to develop a regularly-sampled image (ortho) with the same lack of distortion as a map
- **Mosaicking** – combines multiple orthos into a single large-format ortho product
- **Band Stacking** – combines multiple single band images (each representing a single spectrum) into a multi-band image

## LEFT AND RIGHT VIEWERS

The Left and Right Viewers are used to display and exploit imagery and data layers. One image can be loaded in each viewer, but multiple data layers can be visualized at a time. Each Viewer has its own image, but data layers are shared between viewers.

## IMAGE GALLERY

The Image Gallery contains a set of thumbnails of all raster data loaded in the session. Data is loaded into the Left and Right Viewers by right-clicking on the thumbnail and choosing Send to Left Viewer or Send to Right Viewer.

## DATA LAYER MANAGER

The Data Layer Manager lists all of the data layers in the session. From here, you can use the checkboxes to show/hide layers, and the radio buttons to specify which data layer is the active (editable) layer.

## DATA ACCESS TOOLS

### LOADING DATA

3D FeatureXtract directly loads raster, vector, and other data files from an extensive list of supported file formats. Because no conversion is needed, 3D FeatureXtract offers the advantage of quick access to data, and minimizes the amount of “floating data copies” on your storage devices.

### BATCH AERIAL WORKFLOW

You can use the Batch Aerial Workflow to quickly generate the sensor models for a large number of aerial images within 3D FeatureXtract. The Batch Aerial Workflow will walk you through each of the steps for configuring the sensors models for a handful of images up to thousands at one time. You simply follow the steps to set the fields for your cameras: internal parameters, external parameters, and data pairing parameters.

### PROJECT FILES

IApioneer uses project files, which are a collection of links to data files, to organize and preserve data loaded in a single session for future processing.

# DATA MANAGEMENT TOOLS

## CROP, RESAMPLE, AND REPROJECT

Selecting the Crop, Resample, and Reproject option lets you create a new subset raster from the selected data file, changing its sampling resolution and spatial reference at the same time.

There are four mechanisms for setting the subset (crop) boundaries:

- **Rubber Band Selection** – Drag-select the subset boundaries in the visual layer.
- **Subset Corner Coordinates** – Manually enter the Upper Left and Lower Right image coordinates of the bounding box area.
- **Use Geospatial Coordinates** – Manually enter the Upper Left and Lower Right geospatial coordinates of the bounding box area.
- **From Other Data** – Set the bounding box of the subset from the geospatial boundaries of another data set.

You can use the **Reproject** option to change the spatial reference system of the output raster data. The output spatial reference system can be one of the pre-defined projections, or a custom output projection as specified by a well-known text (WKT) string.

The **Resample** options allows you to specify an estimated ground sample distance (GSD) for the output raster file.

## DATA CONVERSION

Data conversion allows you to convert raster data from one *Data Type* (Byte, Short, Unsigned Short, Int, Unsigned Int, Float, Double) to another. This is a batch process, meaning that multiple images can be processed at a time.

### EXPORT (RASTER)

You can translate a raster image from one format to another using the Export option. The raster Export process is another batch process, where you can translate multiple raster files at one time.

### EXPORT (VECTOR)

The *Export* option allows the user to export the selected vector file, with options for output format, projection, texturing, and more. The *Output Format* parameter includes the most common geospatial 2D and 3D file formats, including:

- GeoVector (IAVO proprietary)
- ESRI Shapefile
- Presagis OpenFlight
- Collada
- KML/KMZ
- Wavefront OBJ
- PLY
- XYZ point set
- Common Data Base (CDB)

Use **Reproject Data** to convert the vector file's spatial reference system from the original to one of your choosing.

Output formats that include texture information can have automatic texturing applied to the data. The automatic texturing

process takes into account camera look angle, spatial resolution, and occlusions to identify the best texture patches for every polygon in the dataset.

- Loft features
- Parametric roofs

## ANNOTATION LAYER TOOLS

You can create and edit annotation layers within IPioneer with the following tools:

- Drawing tools:
  - Draw points, polygons, polylines, ellipses, rectangles, text boxes, point markers, target rings.
  - Add MIL-STD-2525B graphics
- Editing tools:
  - Subdivide four-sided polygons
  - Edit polygon points
- Measurement tools
  - Directly measure angles and horizontal lengths
  - Get perimeter and area measurements from polygons

## PRECISION POINT

### MENSURATION TOOLS

With IPioneer and the IAI Generic Targeting Interface (GTI), you can perform precision point mensuration using the Common Geopositioning Services (CGS) libraries.

## VECTOR LAYER TOOLS

You can create and edit vector layers within FeatureXTract with the following tools:

- Drawing tools:
  - Draw general and rectilinear polygons, circles, polylines, and points.
- Editing tools:
  - Adjust elevation, rotation, and position
  - Move vertices, edges, and polygons.
- Detailing:
  - Extrude to DEM