



# Hydra Fusion Tools™

## Capabilities Guide

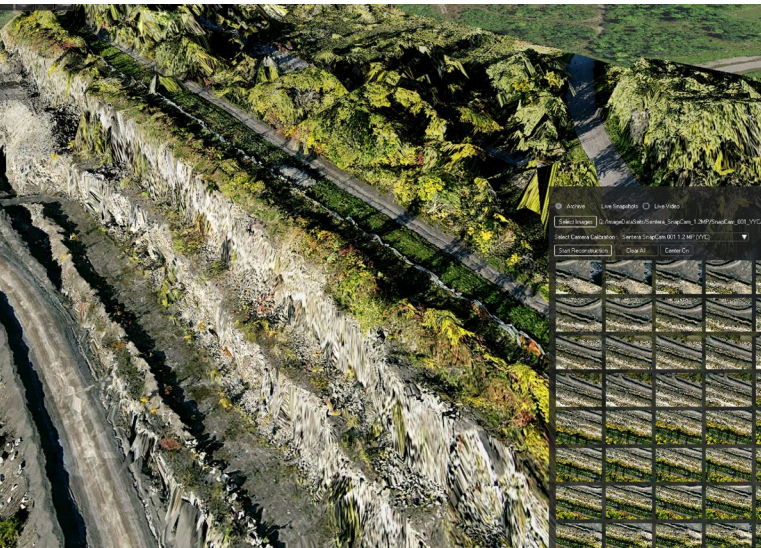
Real-time 3D Reconstructions



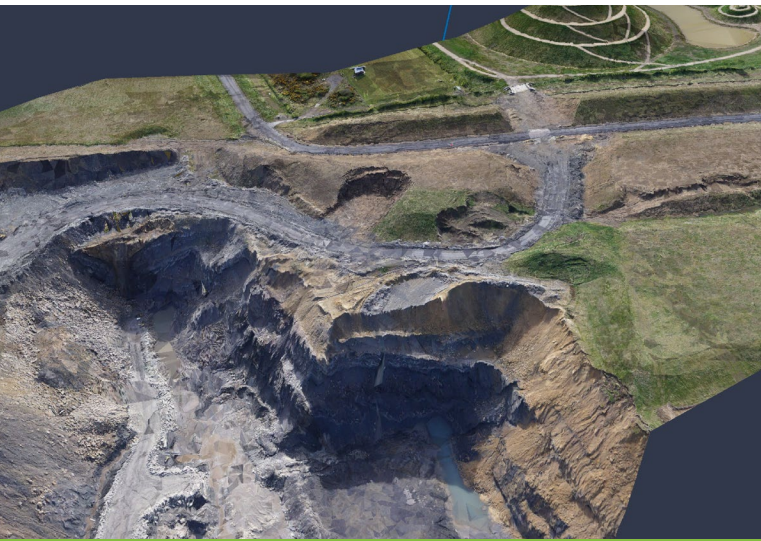




Large-scale Reconstruction of an Urban Area



Reconstruction of a Quarry



Reconstruction of an Open Pit Mine

# Hydra Fusion Tools™

Flying an unmanned aircraft system (UAS) is no longer a stand-alone activity. Operators are inundated with large quantities of disparate data – in the form of maps, images, video, and intelligence – that they must compare and interpret before taking action.

Hydra Fusion Tools™ is a real-time Geospatial Information System that is our answer to the challenges presented by Big Data. Hydra Fusion Tools simplifies information by fusing this data to create a 3D world presentation that gives immediate ‘in context’ information.

The stand-out feature of Hydra Fusion Tools is its ability to simultaneously localize and map (SLAM) incoming video or still image feeds from the aircraft while it flies. These images are incrementally matched up, stitched together, and geo-registered resulting in an immediate and immersive 3D reconstruction. Combined with 3D models of objects, Hydra Fusion Tools creates a rendering of any site – construction zone, industrial plant, mine, or farmer’s field.

Hydra Fusion Tools turns Big Data into actionable intelligence.

## Discover Ease and Efficiency

Hydra Fusion Tools is easy to use, easy to learn, and easily integrates with a wide variety of sensors and unmanned aircraft systems including the Lockheed Martin Indago UAS.

- Start reconstruction with the click of a button when the image feed is available
- Validate and use the reconstruction as it evolves on the 3D map
- Verify data quality in the field to help avoid costly re-flights
- Mark points of interest, perform calculations, and more in a geo-referenced context

## Leverage your Data

Hydra Fusion Tools generates a 3D reconstruction on the fly using a live image feed from the aircraft’s camera during flight, or an image stream stored on disk. While still in the field, you can further enhance your 3D reconstruction and maximize its usefulness:

- Specify ground control points and check points thus improving the accuracy of the reconstruction – positional error is calculated and displayed
- Import DWG files for overlay on your reconstruction – useful for examining an architectural plan in a 3D world context
- Export the immersive 3D reconstruction into a dense LAS point cloud for analysis in other tools
- As a future capability, export to other file formats such as DWG, 3DS, and 2D orthophoto.

# Building a Mapping System

Hydra Fusion Tools has been designed to be agnostic with third party cameras and drone systems. Its ease of integration allows it to be leveraged in a variety of configurations. Connect Hydra Fusion Tools to any system that provides:

- Steaming Video – Simply stream video (UDP or RTP) to the machine running Hydra Fusion Tools for real-time reconstructions from video
- Images On the Fly – Copy images as transferred from the vehicle to a local directory on the machine for real-time reconstruction on the fly
- An Image Set – If your system does not support the transfer of images while the vehicle is in flight, Hydra Fusion Tools is only one battery behind real-time. After the flight, simply copy the image set to the machine for prompt reconstruction.

## Edge Computing

Hydra Fusion Tools brings 3D reconstructions to the edge. A wide variety of mobile hardware (including ruggedized options) meet the system specifications for Hydra Fusion Tools. This enables users to generate 3D reconstructions on the edge, in the field. All processing is local, and no cloud or internet connection is required. You can have results in a fraction of the time.

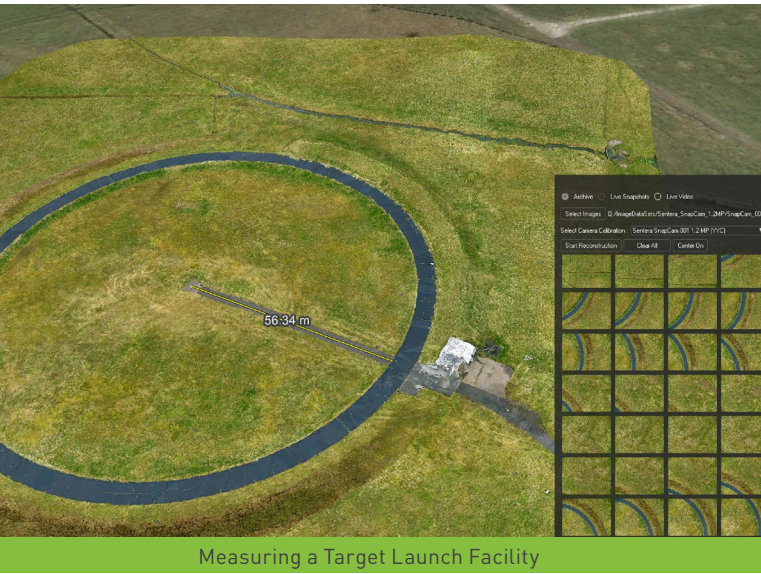
## Cameras

Ultimately the quality of the reconstructions built using Hydra Fusion Tools is directly tied to the quality of the input data and the camera used. Hydra Fusion Tools supports a variety of cameras that are commercially available today. Some camera considerations are:

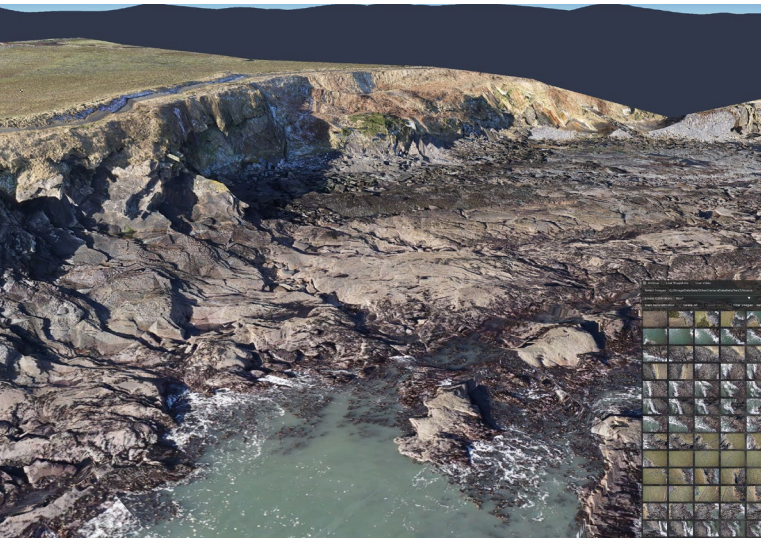
- Shutter – Global shutter cameras are far more accurate than rolling shutter ones. While Hydra Fusion Tools will reconstruct using images from either global or rolling shutter cameras, expect a much higher degree of accuracy when using global shutter cameras.
- Media Access – Some cameras or vehicle architectures restrict access to media while the vehicle is in flight. If your system has this restriction, reconstructions will have to wait until the data is provided to Hydra Fusion Tools.







Measuring a Target Launch Facility



Reconstruction of Shoreline



Video Feed overlaid on 3D World

# Hydra Fusion Tools™ In Action

Hydra Fusion Tools brings context and meaning to the vast amount of data generated from unmanned systems.

## In-Field Measurement

Measuring within a reconstruction is a common need that is supported by Hydra Fusion Tools. While still in the field, you can immediately use 3D reconstructions to:

- Compare construction or site plans to reality by measuring loaded DWG files against reconstructions
- Perfect placement of building elements by ensuring they are always located according to plan
- Measure infrastructure elements in hard-to-reach places. For example, reconstruct a tower to determine antenna placement and dimensions without the need for a physical inspection.

## 3D Mapping

Hydra Fusion Tools generates useful and valuable data products from its reconstructions. You can generate these data products in the field and confirm their accuracy before even leaving the site. A reconstruction can be exported into LAS file format. Reconstruction export to other file formats such as DWG, 3DS, and 2D orthophoto will be available in late-2018.

## Situational Awareness

Lockheed Martin CDL Systems’s experience in unmanned systems stretches back over 20 years and includes 1.5 million flight hours. From working with large UAVs in a variety of military settings, Hydra Fusion Tools was originally conceived to bring context to a data feed.

Provide meaningful context to any video feed by overlaying it on the 3D world, thus removing the pinhole effect and enhancing your situational awareness. Mark and export targets and items of interest. Integrate with chat systems enabling effective communication and easy-to-use tools such as automatic coordinate recognition. Hydra Fusion Tools enables situational awareness through live 3D reconstructions into a single package.

## Supported Data Formats

Hydra Fusion Tools supports a variety of data formats, enabling you to easily integrate your existing data and create useful data products.

	Import	Export
200+ Common Map formats	✓	
DTED	✓	*
Native Format	✓	✓
3DS	✓	*
DWG	✓	*
GeoTIFF	✓	*
DEM		*
LAS (Point Cloud Data)		✓
PNG		✓
Orthophoto (Geo-referenced)		*

\* Future Capabilities

## Hardware Specifications

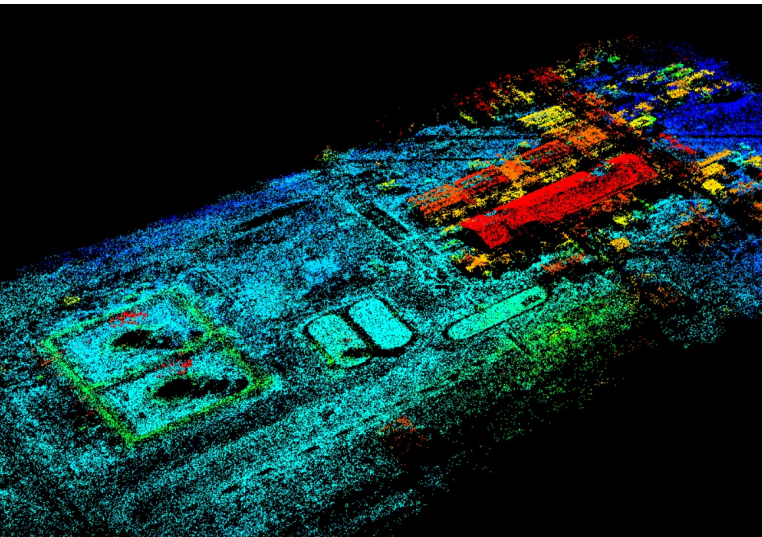
Hydra Fusion Tools runs on commercial hardware and does not require costly LTE or cloud connections. All processing and data remains with you, in the field.

### Minimum

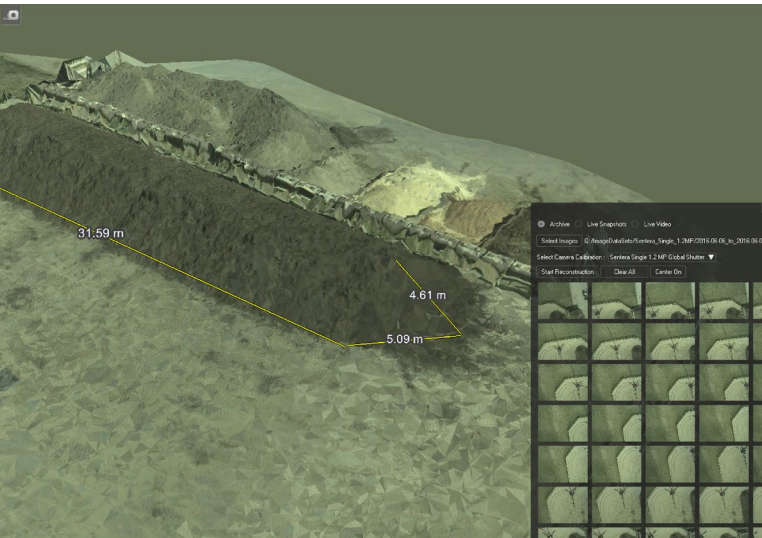
- Microsoft® Windows® 7 with Service Pack 1 and KB3125574, 64-bit
- 4th Generation Intel® Core™ i7, or Intel® Xeon® equivalent
- NVIDIA® GeForce® GTX™ 960 [4 GB]
- 16 GB DDR4 RAM
- 30 GB of available hard-disk space

### Recommended

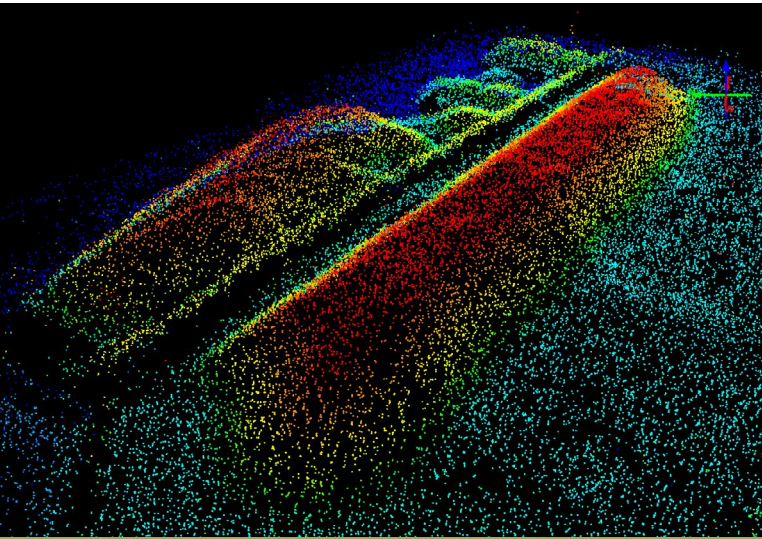
- Microsoft® Windows® 10, 64-bit
- 5th Generation Intel® Core™ i7, or Intel® Xeon® equivalent
- NVIDIA® GeForce® GTX™ 1080 [8 GB]
- 32 GB DDR4 RAM



Exported LAS Point Cloud of a Gas Plant



Reconstruction of land area with Fill Materials



Exported LAS Point Cloud of land area with Fill Materials



# Features at a Glance

**Layers**  
Place, move, show, or hide one or more imported models in your map view.

**Models**  
Place, move, show, or hide one or more imported models in your map view.

**Tracks**  
A track is an uninterrupted sequence of stitched images. If your reconstruction has multiple tracks, you can work with them individually or collectively.

**Point Cloud View**  
View one or more tracks of the reconstruction as point clouds.

**Enhance**  
Enhance one or more tracks of a reconstruction to improve visual appearance and produce a water-tight 3D model.

**Save/Load**  
Save the current reconstruction; Load a saved reconstruction.

**Export**  
Export the tracks of reconstructions into LAS file format.

**Measurement**  
Measure distances within your map view.

**Orthographic View**  
Switch to Orthographic view to enable uniform scale in the 3D map, thereby allowing easy comparison to plans and architectural drawings.

**Surface Imagery / Terrain Import**  
Import maps and DTED for integration to form the basis of your map view.



**Position & Altitude**  
Always see the reconstruction relative to the map coordinates it is referenced to.

**Added Model**  
Add one or more imported models to your map view for additional context or for comparison to plans.

**Point of Interest**  
Mark and label points of interest anywhere in your map view.

**Current Image Viewport**  
See the current image (video or still image) as it is being streamed during flight to produce your reconstruction.

**Reconstruction Source**  
Select the input source for the new reconstruction –live video feed, still images feed, or archived images.

**Settings**  
Conveniently access and adjust global application settings.

**Ground Control Points**  
Assign ground control points to a reconstruction to improve overall accuracy.


**Snapshots**  
Take and save snapshots of your map view for subsequent use.

**Camera Calibration**  
Reconstruct from any previously configured camera.

**Thumbnails**  
See the sequence of individual images that were used in the reconstruction.







# Lockheed Martin. Your Mission is Ours.<sup>TM</sup>

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PIRA: OWG201707002