



# Full Motion Video Add-In for ArcMap 10.x Frequently Asked Questions

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See <http://esriurl.com/FMVFAQpro> for FMV in ArcGIS Pro

## What is FMV?

Full Motion Video (FMV) enables you to view and analyze geospatially referenced video data within your ArcGIS environment. The geospatial metadata required for compatibility in FMV is referred to as “MISB” format, and must be embedded in the video file. See more information below and in ArcGIS Help about the MISB metadata format.

ArcGIS Pro: FMV has been built into ArcGIS Pro since version 2.2, for users with the **Image Analyst** extension. This document refers to ArcMap 10.x. See <http://esriurl.com/FMVFAQpro> for FMV in ArcGIS Pro.

FMV is available as an **add-in** for ArcMap10.5.x through 10.8, including the Video Player and associated geoprocessing (GP) tools. Note that this version will be recompiled for compatibility with future releases, but no new development is being applied to the add-in for ArcMap.

## How do I get FMV for ArcMap?

ArcMap 10.5.x and later:

Please go to the Full Motion Video product page <http://www.esri.com/fmv> and scroll to the bottom for full licensing instructions. The FMV landing page outlines two ways to license the product. The first is via TeleBusiness, which lets you place your order via phone. Once the phone order is processed, you will receive an email that includes an authorization number to activate FMV and a link in your My Esri portal with a token that gives you download permission. You can call (800) 447-9778 between 8am – 5pm PT Monday – Friday. The second method is through your My Esri account. Log in to your My Esri portal ([my.esri.com](http://my.esri.com)) and click on the Downloads tab under ‘My Organizations’. Select the version of ArcGIS for Desktop that you currently own and click on the Download link at the top of the page, in the ‘Get Started’ box will be a link to request the Full Motion Video License.

## How much does FMV cost?

For ArcMap, the FMV add-in and GP tools are free if you’re current on maintenance for ArcGIS Desktop. Otherwise, there is a one-time licensing fee of \$19.99. Once registered, you can use as many instances of the FMV add-in and GP tools as you want under the licensed account. Your order can include more than one license for the same fee.

## Can I use FMV in a web map/web app?

No, not at this time. We are evaluating requirements for deploying FMV capability in a web app.

## Can I use FMV in ArcGIS Runtime?

Not at this time.

## What are the license requirements to support FMV?

FMV in ArcMap is accessible using any license level (Basic, Standard, or Advanced), but note that a Standard or Advanced license is required to use the geoprocessing tools that create mosaic datasets: **FMV Mosaic Video** and **Mosaic Video Frames** geoprocessing tools.

### **What video formats are supported?**

FMV will play video from any camera that records any of 7 common file formats including MPEG, MPEG-2, MPEG-4, MPEG-2 Program Stream (PS), MPEG-2 Transport Stream (TS), H264 and ESD (VOB). 4K x 4K format video is supported.

Also **note that \*.mov format video files are often (but not always) H264 format**, so if you have \*.mov files, make a copy of a test file and rename the extension to \*.h264, then try playing it in FMV. If it works in the video player but does not have embedded MISB metadata, you can proceed to the next step of multiplexing to add location and orientation metadata into the video file.

### **Is there a maximum file size for videos?**

No, there is no maximum file size.

### **Can FMV display real-time video feeds from surveillance cameras, or a realtime downlink from an aircraft?**

FMV currently supports direct connection to live video streams such as Internet Protocol version 4 (IPv4) addresses and both the User Datagram Protocol (UDP) and the Real Time Streaming Protocol (RTSP). MPEG TS streams can be broadcast as UDP unicast or multicast and can include MPEG-1, MPEG-2, and H.264 video decoding, and KLV metadata parsing. RTSP playback is supported for live RTSP streams that use any of the following video codecs: MPEG-1 Video, MPEG-2 Video, H.264, and MJPEG.

Entire videos or partial segments can be recorded and stored to disk in real time from the live video feed. Viewing is supported, but more importantly virtually all video functions are supported including marking, measuring, bookmarking, mosaicking, digitizing features, and more, all in real-time during the live video feed, assuming the live stream is MISB-compliant. This capability is important for real-time situation awareness, ISR (Intelligence, Surveillance and Reconnaissance) and emergency management operations.

### **What are the minimum metadata requirements?**

The minimum geospatial metadata includes the latitude, longitude and height (i.e., GPS location) of the camera, orientation angles for where the camera is pointing known as pitch, roll, and heading (from the Inertial Measurement Unit (IMU)), and sensor field of view. These parameters are described in more detail at the end of this FAQ.

This metadata is encoded into the video stream to produce a MISB-compliant video. If your sensor system produces the video and metadata as separate files, the **Video Multiplexer** geoprocessing tool will combine them into a MISB-compliant video.

If the minimum required metadata described above is provided, FMV provides a moving footprint of the video on the map, as well as a dynamic path of the aircraft presuming the video was captured from the air. GIS feature data (points, lines, polygons) can also be projected into the video as graphic overlays.

If your metadata is limited, for example [x,y,z] location of the camera from GPS is recorded but no sensor orientation information is available, some functionality of FMV will be limited.

| GIS and Mapping Support              | Video with MISB compliant metadata | Video with location only |
|--------------------------------------|------------------------------------|--------------------------|
| Video footprint on map               | yes                                | no                       |
| GIS features displayed in video      | yes                                | no                       |
| Aircraft flight path shown on map    | yes                                | yes                      |
| Measure features in the video        | yes                                | no                       |
| Mark features in the video           | yes                                | no                       |
| Save video frame as an image         | yes                                | yes                      |
| Export video clip                    | yes                                | yes                      |
| Create Powerpoint report             | yes                                | no                       |
| Collect / label / save Bookmarks     | yes                                | yes                      |
| Play video controls (pause, FF, etc) | yes                                | yes                      |

### Does video data need to be MISB-compliant to work in FMV?

Not necessarily, although to use all of the features of FMV, the answer is yes. Lacking MISB metadata, any video in the formats listed above can be played and viewed (pan and zoom) in the FMV video player. However, videos need to have geospatial metadata in a MISB-compliant format to be able to see the sensor ground track, video frame displayed on the map, and to map between the video player and the ArcGIS display. See table above.

### What is the MISB standard, and why is it important?

The Motion Imagery Standards Board defined the MISB standard for encoding various metadata parameters into the video stream. The metadata enables advanced capabilities such as locating the video frame on a map, locating and mapping features within the video frame, viewing the sensor ground track and pointing direction, and multicast broadcasting.

Support of the MISB standard is important for interoperability between FMV, ArcGIS, and other applications and systems related to defense ISR, situation awareness, emergency management, monitoring and mapping.

### How do you integrate the metadata with the video file in FMV?

Depending on the source, the MISB metadata may already be embedded in the video stream. If not, and you have separate files for video vs. position and orientation metadata, use the **Video Multiplexer** geoprocessing tool (in the FMV toolbox). It requires 2 main inputs: the video file and the metadata in a csv file. This is described in the FMV documentation ([User's Manual](#) for ArcMap, or see **Help** for ArcGIS Pro) and multiplexer templates. If you collect the minimum metadata listed above in a csv file, the FMV **Video Multiplexer** will calculate the video frame corners, and thus the size, shape, and position of the video frame outline and display it on the map. This type of information is usually readily available from commercial IMU (Inertial Measurement Unit) and GPS systems, or you may have to enter estimated values for some parameters, resulting in a limitation on the accuracy of the results. Please note that without all of this data, either from a sensor or with reasonable estimated values, there will be no way to calculate a frame outline.

A multiplexer template is provided (Video\_Multiplexer\_MISB\_Field\_Mapping\_Template.xls) which maps the field names in your metadata csv file to the MISB field names. Another template is provided to accommodate any time offsets in your data, for example if your video

recorder was activated before your metadata instruments (i.e., GPS and IMU) were turned on, you can apply a time offset as input to the multiplexer.

### **Can the GPS data come from a \*.gpx file?**

Yes. GPS and IMU metadata can be recorded in GPX format, which is easily imported into a spreadsheet as XML format (make a copy of the file, and change the \*.gpx extension to .xml), then edit the file to ensure the data is formatted properly before it is input into the **Video Multiplexer** geoprocessing tool.

### **How is a video archive created and indexed for searching?**

The metadata must first be extracted from the video stream, then used in the search. The 4 corners of the video frames and timestamp are extracted and stored in a GDB. The extent of these footprints is searched for intersection with the search criteria defined: selected features, and/or display or clipped display extent, and/or time. The metadata can be extracted in 2 different but related workflows, either via the **Extract Metadata** geoprocessing tool, or via the **Video Search** tool dialog which guides you through the process. You can specify the metadata extraction rate and video playback rate which results in faster performance of both the metadata extraction process and the time searching.

### **Which specific UAV or drone models are MISB compliant?**

Esri is drone and sensor agnostic, i.e., FMV will work with data collected from any platform and sensor as long as it meets minimum requirements addressed here. We are not able to maintain a list of MISB compliant cameras or UAVs since they change frequently. MISB-capable systems are not very common and are relatively expensive, typically deployed on military drone or industrial aircraft platforms that include onboard computers to multiplex the data in real time.

FMV can support virtually any video camera/sensor system as long as the required metadata is collected in a readable format such as CSV or GPX file. Presuming you do not have video with MISB metadata already embedded, the **Video Multiplexer** tool will combine the video and metadata into a compatible video data stream suitable for use in ArcMap.

The metadata is provided by instruments onboard the imaging platform, and in some cases may be supplemented with values that are *estimated* based on the camera and platform. GPS provides the Time Stamp, SensorLatitude, SensorLongitude, SensorAltitude, and PlatformHeading. The IMU (Inertial Measurement Unit) or gimbal data encoder, if available, provides platform and sensor Pitch, Roll and Yaw. The camera manufacturer or simple calculations can identify the field of view for the camera. This metadata is common to many drones, and is combined with the video data using the **Video Multiplexer** GP tool.

### **Can videos be stored within a geodatabase?**

The video files are not managed in the geodatabase due to file size, but the metadata about the video should be managed in a geodatabase, then can reference the source video files on disk or in the cloud. Storing metadata about your videos as Feature Classes enables the powerful **Video Search** capability of FMV, where the metadata may be searched according to location of the map, existing GIS features, and/or time. The search tools find the appropriate video files and temporal position of the appropriate segment in the video file in the results.

### **Can you measure object heights in the video player?**

The current version of FMV Add-in for ArcMap does not support measurements in 3D (height of features). Only 2D linear measurements are currently supported, but this is available in ArcGIS Pro.

### **Can Full Motion Video be used with video of underground utilities?**

Yes, if the location of the sensor is recorded (latitude and longitude), along with time stamp, the ground track of the sensor will also be displayed on the map in ArcMap.

### **Does FMV work with mobile video (e.g. law enforcement dash cam)?**

Yes, FMV will work with mobile video if the video is in one of the supported video types, and has metadata (a minimum of Latitude, Longitude, and Unix Time Stamp), and the video and metadata are multiplexed together. One consideration with dash cams is their view orientation. If any part of the video frame views above the horizon the frame footprints reach out to the horizon, and are not generally usable. The best solution to this is to add an artificial pitch angle as if the sensor was always pointed below the horizon. Another option is to omit the frame corners, and simply display the latitude and longitude of the sensor.

### **What happens in FMV if the camera is aimed at or above the horizon?**

If the camera is aimed above the horizon the metadata will contain values that can't be resolved in the context of placing a video footprint on the ground. As a result, you'll often see oddly shaped polygons or no frame data at all on the map. In this mode, it is recommended to disable the display of the Frame Center and Frame Outline, and use only the Field of View and Platform displayed on screen to provide context.

### **What are the minimum metadata requirements to enable mapping between the video player and the ArcMap display?**

The MISB standard is very robust and covers many aspects related to the physical and environmental conditions of data collection. However, only a subset of the metadata parameters are needed for FMV to compute the 4 corners of the video frame on the map and enable mapping on the video player and map. Essentially, all you need for a given point in time is the location of the imaging platform determined by GPS (x, y and z), and orientation or attitude of the sensor commonly expressed as Heading, Pitch, and Roll (or Tip, Tilt and Yaw), as well as the field of view of the sensor.

Thus, in order for FMV to project the 4 corners of the video frame on the reference map in ArcGIS, the following 8 parameters need to be collected at a minimum:

From GPS:

- UNIX Time Stamp: Coordinated Universal Time (UTC) represented in the number of **microseconds** elapsed since midnight (00:00:00), January 1, 1970. Derived from the POSIX IEEE 1003.1 standard. Resolution: 1 microsecond.
- Sensor Latitude: The location of the sensor aboard the imaging platform. Based on WGS84 ellipsoid.
- Sensor Longitude: The location of the sensor aboard the sensor platform. Based on WGS84 ellipsoid.
- SensorAltitude: The height above or below mean sea level of the sensor aboard the sensor platform.
  - Note: Although in the MISB standard this field is defined as the height of the sensor relative to mean sea level, when running the Video Multiplexer in ArcMap this value must represent the height of the sensor above ground level (AGL), or if

the values is height above sea level, a DEM must also be used to convert the heights to AGL.

The above parameters enable display of the sensor ground track on the map. The additional parameters that follow are recommended, to enable projection of the footprint onto the ground:

From the IMU:

- Platform Heading: Aircraft (or vehicle) heading angle, in degrees. Measured from forward longitudinal axis relative to True North in the horizontal plane, positive clockwise. (0...360, where "due East" would be 90).
- Platform Pitch: Aircraft pitch angle determined by the rotation around the side-to-side axis of the collection platform, also described as nose up or nose down, measured positive upward. (0...+/- 20). Note that Pitch = 0 means the platform is aimed toward the forward horizon, so for a sensor aimed at nadir (straight down), the SensorRelativeElevation (see below) would be approximately -90.
- Platform Roll: Aircraft roll angle determined by the rotation around the front-to-back axis, measured positive clockwise when viewed from behind. 0 means level flight, +10 degrees means airplane right wing is lower than left wing.

From the Camera manufacturer, and sensor internal electronics (or a known fixed value):

- Horizontal FOV: Horizontal field of view of selected imaging sensor, in decimal degrees. For a sensor with variable zoom, note that this value may vary as a function of time.

Presuming the sensor is not aimed straight forward (may be a fixed mount, or mounted on a gimbal), 3 additional measurements are needed:

- Sensor Relative Azimuth: Relative rotation angle of the sensor relative to the aircraft longitudinal axis. Rotation angle between platform longitudinal axis and camera pointing direction as seen from above the platform, measured positive clockwise in degrees.
- Sensor Relative Elevation: Relative pitch angle of the sensor to the aircraft longitudinal-transverse plane, measured in degrees positive upward. A camera aimed toward the direction of flight would show SensorRelativeElevation = 0, whereas a camera aimed out of the floor of the aircraft would show -90.
- Sensor Relative Roll: Relative roll angle of the sensor relative to the aircraft. Rotational angle of the camera about its lens axis. Top of image is zero degrees. Positive angles are clockwise when looking from behind the camera.

The parameters above are well described in the MISB standards document.

Go to [http://www.gwg.nga.mil/misb/zip\\_pubs.html](http://www.gwg.nga.mil/misb/zip_pubs.html) and download the zip file titled 'MISP-2016.1'. Unzip the file and look for a folder called 'MISP-2016.1CompositeDocuments'. Open the folder and look for a pdf called 'ST0601.9.pdf'. This pdf contains a reference to all of the MISB fields supported by the FMV tool set. It also includes descriptions of the parameters and useful diagrams.

### **Is possible to measure any feature accurately?**

This will depend on the accuracy and frequency of the metadata, the off-nadir view angle and distance from the features of interest. Measurements can be accurate, but for best accuracy, it is recommended to use a nadir or near-nadir viewing angle. Long oblique view angles will naturally lead to less accurate measurements.

### **Can we extract frames from FMV to create an orthomosaic or surface model??**

Video frames and georeferencing information can be exported as GeoTiff, NTF and JP2000 format. These video frames can be input to another software application such as Drone2Map to generate a DSM (assuming proper stereo overlap, etc.) and/or orthomosaic. Note that, for this use case, a nadir or near-nadir camera orientation is required. You may also need to define a nominal camera model for the video camera.

**Does the Esri Full Motion Video Add-In support audio (sound)?**

No, not at this time.

**I have multiple videos – can FMV work with more than one at the same time?**

Yes, it is common to open and review multiple videos simultaneously.

**When I am playing multiple videos, if they were captured at the same time, can FMV synchronize the video playback?**

No, this is not possible in ArcMap.

**Does the (Sensor True Altitude) field support continuous data values?**

Generally yes, although the values are quantized to approximately 1/3 meter. Sensor altitude is stored and displayed as a floating point value, but the precision is limited by this data quantization.

**I am capturing single frames from the video, but some of the frames are PNG format and not georeferenced. What is causing that?**

As noted in the Properties menu/Imagery tab for the video window, if metadata is not available for a section of the video, images from that clip cannot be georeferenced. If this is a video you have processed with the multiplexer, there are likely to be temporal gaps in your metadata file. You may need to reprocess the metadata, and fill in any missing time stamps, then interpolate (X,Y,Z) and Heading, Pitch, and Roll across those new times. This data may not be highly accurate but will enable ArcGIS to generate single frames that are approximately georeferenced.

**Does FMV support panoramic or 360 degree view cameras?**

These cameras can be partially supported, but note that some features of FMV are not applicable. One of the key features of FMV is to put the video footprint on the map, and with a 360 camera, the footprint has no left/right boundaries. Further, in most scenarios the upper portion of the video frame would typically view above the horizon, so the footprint would effectively cover everything to the horizon in all directions. An arbitrary value could be applied to limit the visible extent, but the only metadata that would make logical sense would be to show the camera location (not field of view) on the map (x,y,z). This may have value, but features such as digitizing in the video or projecting feature data into the video would not be available.

**I ran the multiplexer and got this error. What is wrong?**

```
Executing: VideoMultiplexer
(rows deleted)
Execute(): Object reference not set to an instance of an object.
Failed to execute (VideoMultiplexer).
```

This error message occurs if you have the metadata file open in another program (e.g. typically Microsoft Excel). Close the metadata.csv file and re-run the multiplexer.

**Where can I find for detailed information about the Esri Full Motion Video Add-In?**

Links to information about FMV are available on the FMV homepage [www.esri.com/FMV](http://www.esri.com/FMV)

The Full Motion Video category on GeoNet is the best place to find lots of info about FMV. Information includes the FAQ, links to blogs, Training Exercises including sample data, webinars and Live Training Seminars and more.

<https://geonet.esri.com/community/gis/imagery-and-remote-sensing/content?filterID=contentstatus%5Bpublished%5D~category%5Bfull-motion-video%5D>