FULL MOTION VIDEO TUTORIAL

AUGUST 2016

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FMV TRAINING EXERCISES

Overview

The main goal of these training exercises is to familiarize users with the Full Motion Video Add-In 1.3.1, which is supported in Desktop 10.3.x and 10.4.x. This will be accomplished with descriptions of important FMV capabilities followed by exercises to cement the concepts and standard workflows. "Important concepts" are those identified by our users who use FMV in their day-to-day operations.

A secondary goal is not to overwhelm you with all the capabilities of FMV, which are considerable. We have in-house experts, customer service and other resources to handle questions regarding the many user cases and robust capabilities of FMV that you can refer to. We will focus on the capabilities that excite our customers and are deemed important by users. These exercises will help you to be familiar with, conversant about, FMV.

DESCRIPTION OF THE EXERCISES

The theme of these exercises is guided by the tools and capabilities needed to support an important operational scenario use case - Situation Awareness. The workflow is essentially:

- Find existing data and information
  - You need to locate all the videos that cover a specific geography for a specific time period
- Analyze
  - Incorporate existing GIS data
  - Update the GIS data
- Disseminate
  - Save a snapshot and a video clip
  - Generate a report

There are 3 exercises which address the three main components of the FMV 1.3.1 Add-In, The Video Player, The Video Manager and the GP Tools. Exercise 1 will familiarize you with the Video Player, Exercise 2 addresses analysis, GIS update and video search, and Exercise 3 covers how to multiplex asynchronous video and metadata into a MISB-compliant video.

Download the data and support material for the exercises at http://esriurl.com/FMVexercises

Videos, data and documentation for this exercise are organized into 4 directories. Please create a root directory such as C:\Temp and copy this top directory \FMV_Exercises there. The four subdirectories include:

…\Documentation which includes the FMV 1.3 Add-In User's Manual, exercises and other support material

…\Videos which contains the video files

…\Data which includes .MXD's, shapefiles, and File Geodatabases,(FGDB)and other ancillary data to support the exercises

…\Multiplexer which includes all the video, csv and documentation files pertaining to the Video Multiplexer GP tool.

It is assumed that you have downloaded the FMV 1.3.1 Add-In from My Esri at my.esri.com

Have Fun!

Overview of the Video Player: Exercise 1

The purpose of this exercise to familiarize you with the basic functionality of the video player. Not all of the available functionality is addressed in this exercise, and you are encouraged to explore the video player more thoroughly.

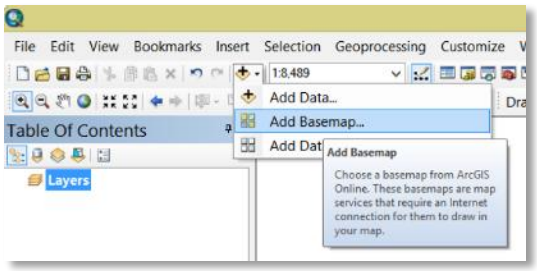
As noted in the previous page, all the data and support material are located in

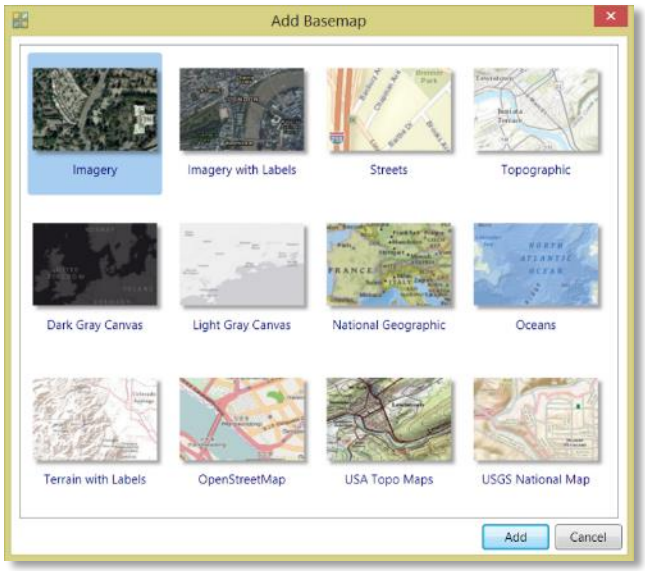
http://esriurl.com/FMVexercises

The video data used in this exercise is MISB-compliant which enables the video frame footprints to be displayed on a map in ArcMap. The position and ground track of the sensor platform and look direction of the sensor is also displayed as the video plays.

OPEN ARCMAP AND THE FMV ADD-IN

1. Open ArcMap 10.x which includes the FMV 1.3.1 Add-In and GP tools
2. Load an image basemap into ArcMap



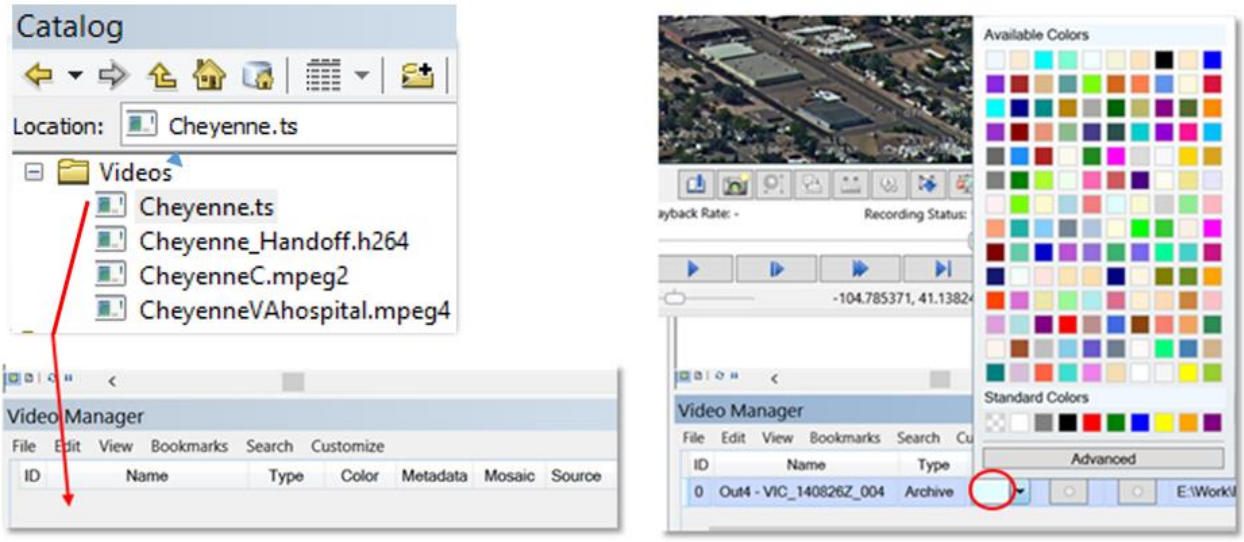


3. Make sure the FMV Toolbar is displayed and docked

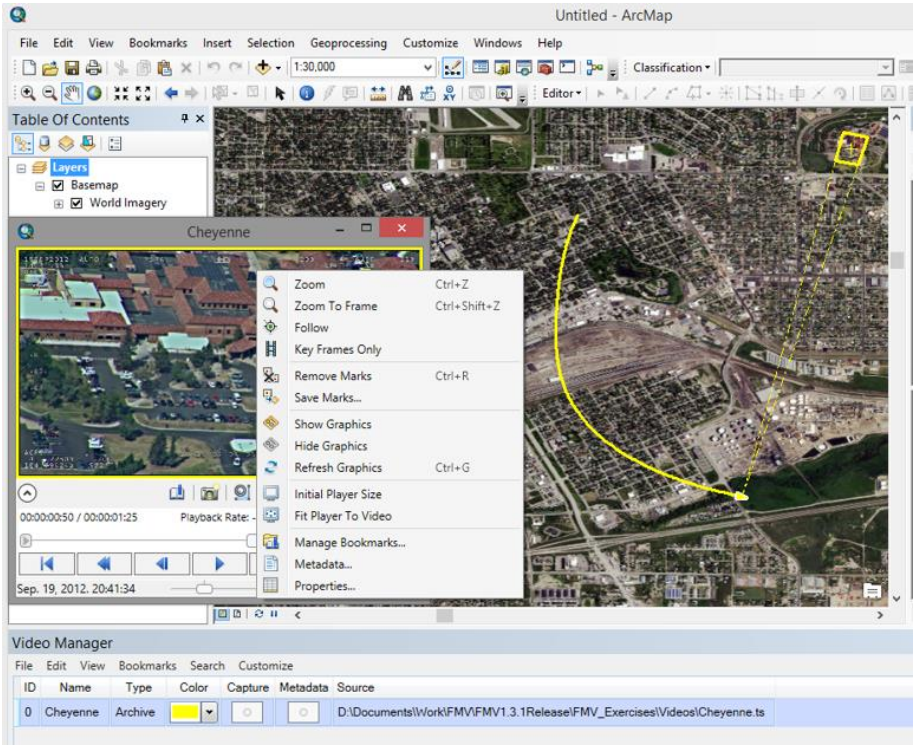
4. Open the Video manager and dock it at the bottom of the display

PLAY AN ARCHIVED VIDEO

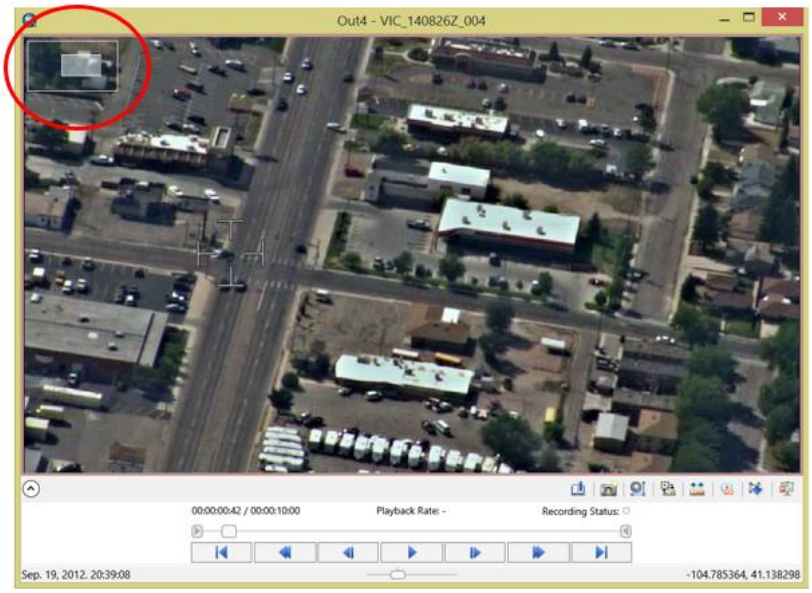
1. Load *Cheyenne.ts* video by dragging it from the Catalog window into the video manager docked at the bottom of the ArcMap display window.
    a. The video player will open
    b. Select a notable reference color for the video display (e.g., yellow or red).



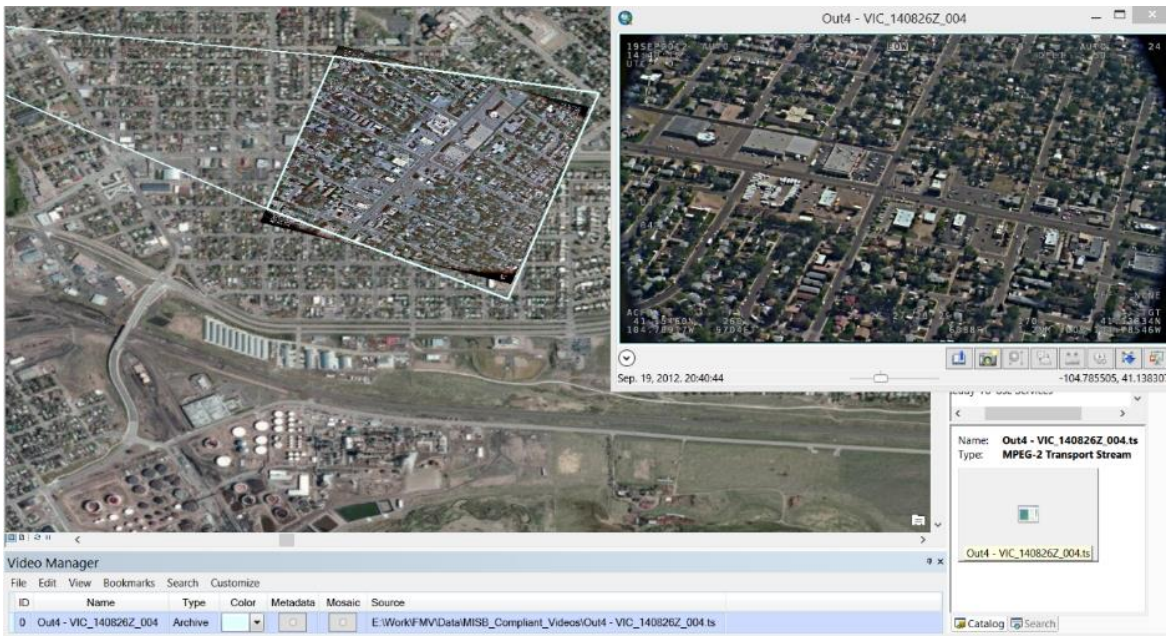
2. Click the play button on the video player. The video will begin to play in the video player
3. Right click on the video in the video player which displays a pick list of options. Select *Zoom* which displays the ground track of the collection platform, heading and the video frame on the map.



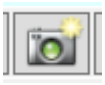
4. Select *Follow* so that the map pans to keep the sensor and video frame footprint visible in the display
5. Resize the video player. Pan and zoom in the video player window using your mouse and finger wheel. The position and relative size of the zoomed view within the video frame is displayed in the upper left corner of the overview window in the video player.



6. Fast forward using the buttons and speed slider, click the play button to go back to 1X speed. Try rewind, pause and step.



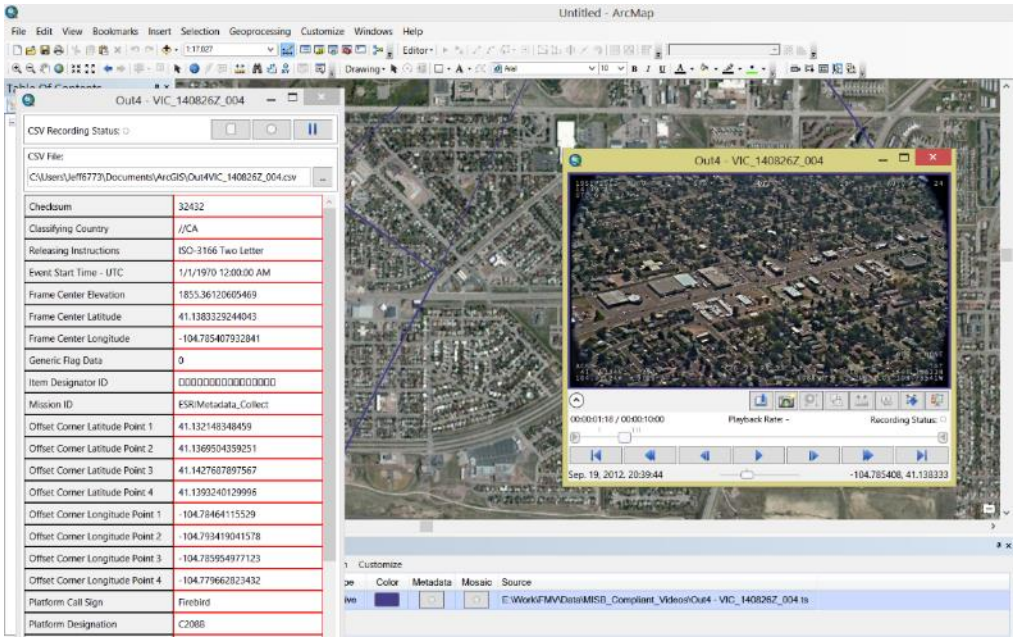
DISPLAY A VIDEO FRAME IN THE MAP



Click *Save the video frame as an image* on the video player to display the video imagery data on the map. The layer will be listed in the Table of Contents. You may want to swipe this video frame layer over the basemap. Do this by going to the main tool bar Customize => Toolbars => Effects and dock the tool bar. Make sure the video frame layer is selected in the Effects Layer dropdown, then grab an edge of the layer with a left mouse click and swipe it over the basemap.

DISPLAY METADATA

While the video is playing, right click on the video in the video player and select Metadata in the dropdown options. This displays the metadata table which is continuously updated as the video plays.



MARKING THE VIDEO AND MAP

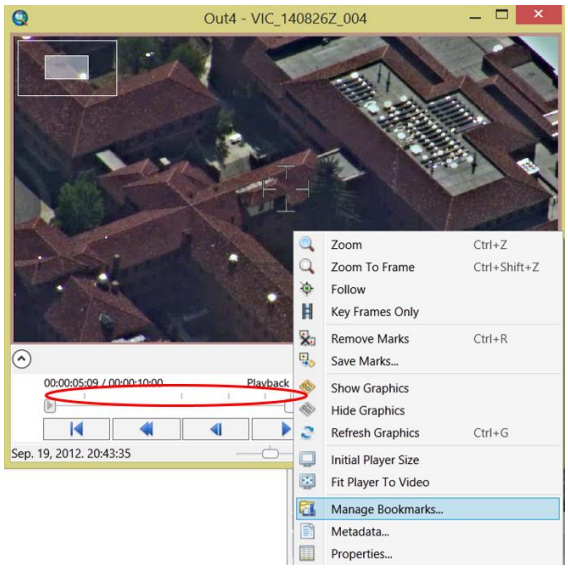
Select *Mark map and video* from the FMV Toolbar in the video player, then digitize points along a road in the video player. These marks will also be displayed on the Map. Mark other features on the video to see the corresponding marks on the map, and vice versa (i.e., mark the map to see marks in the video). Right click in the video player and select Remove Marks; conversely, select Save Marks to save the marks as a point featureclass in a geodatabase.

MEASURE

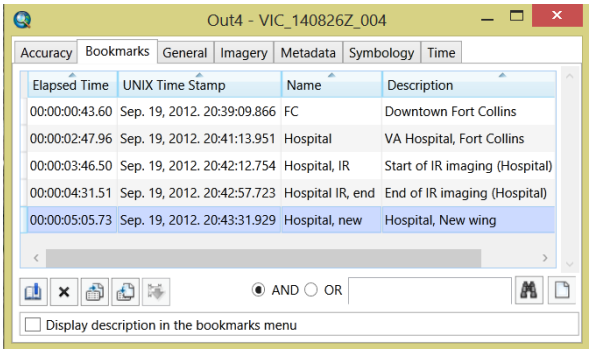
Click the Measure tool on the video player to make linear measurements on the video. Measurement will be cumulative line segments in meters. Choose metric or imperial measurement units by clicking the “Customize” tab on the main menu in the Video Manager. Area and elevation measurements are not supported at this time.

BOOKMARKS

1. As you play the video, create bookmarks by clicking on the bookmark icon on the video player. Bookmarks are indicated by tick marks on the time slider of the video player.

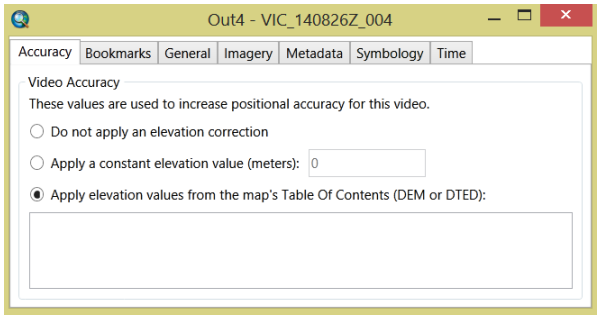


2. Bookmarks are managed on the Bookmark tab on the video Properties dialog. Add a description for your bookmarks. You may also manage bookmarks by right click in the video player and select “Manage Bookmarks” which opens the Bookmarks tab in the properties dialog.



PROPERTIES

Display the Properties of a video be either right clicking in the video player, or by selecting and right clicking on the video file in the video manager. The Properties dialog opens for the video selected. You will see a series of tabs for the topics; these are mostly self-explanatory. The detailed descriptions of the tabs is addressed in the FMV Add-In User’s Manual.



SUMMARY OF EXERCISE 1

In Exercise 1 we reviewed various functionality and tools to operate the Video Player. The Video Manager was also introduced. You are encouraged to explore the functionality of both the video player and manager. Please refer to the FMV 1.3.1 Add-In User’s Manual for more details.

Video Search and Analysis: Exercise 2

This exercise reviews two powerful and useful capabilities inherent in the FMV Add-In, conducting a video search based on geolocation and a feature in a feature class shapefile, and updating the feature layer.

MAP UPDATE

A very important capability of the FMV Add-In is the ability to seamlessly map features in either video image space or map projection space. This enables users to draw and compile feature data right on the video in the video player and have the features mapped and displayed in real time on the map in the ArcMap display. Conversely, feature class data can be created or edited in the ArcMap display and be displayed in real time on the video in the video player.

VIDEO SEARCH

A great and extremely useful capability in the FMV Add-In is to search archived videos for a geography and feature of interest. You can imagine the daunting task of finding a particular area of interest in an archive of video files containing many hours of video data and potentially tens, hundreds or even thousands of videos. The video search capability makes this an easy task and enables the utility of archived video information to address operation scenarios.

These instructions for Exercise 2 and the FMV 1.3.1 Add-In User's Manual are in the C:\Temp\FMV_Exercises\Documentation directory, the video data is in

C:\Temp\FMV_Exercises\Videos and other required data is in the

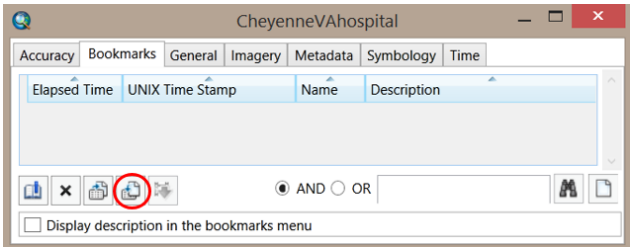
C:\Temp\FMV_Exercises\Data directory.

The video data used in this exercise is MISB-compliant which enables the video frame footprints to be displayed on a map in ArcMap. The position and look direction and ground track of the sensor is also displayed as the video plays

OPEN ARCMAP AND THE FMV ADD-IN

1. Open ArcMap 10.3.x or 10.4.x which includes the FMV 1.3.1 Add-In and GP tools
2. Load *CheyenneVAhospital.mpeg4* video by dragging it from the Catalog window into the video manager docked at the bottom of the ArcMap display window.
3. Make sure the FMV Toolbar is displayed and docked

4. Open the Video manager and dock it at the bottom of the display
5. Load *CheyenneVAhospital.mpeg4* video by dragging it from the Catalog window into the video manager docked at the bottom of the ArcMap display window.
    - The video player will open
    - Select a color for the video display information
6. Load *VA_Hospital_Vic004_WGS84.shp* shapefile (C:\Temp\FMV_Exercises\Data). Give each layer a distinctive color such as yellow and red, and assign a transparency of about 20%
7. Right click on the video in the video player and choose "Manage Bookmarks". This opens the Properties dialog. Load the *CheyenneVAhospital_Bookmark.csv* bookmark (C:\Temp\FMV_Exercises\Data). Note the descriptions and the function buttons. Close the dialog.



8. Click the play button on the video player. The video will begin to play in the video player. Fast forward, step backwards, resize the player.

UPDATE FEATURE DATA ON THE VIDEO AND MAP

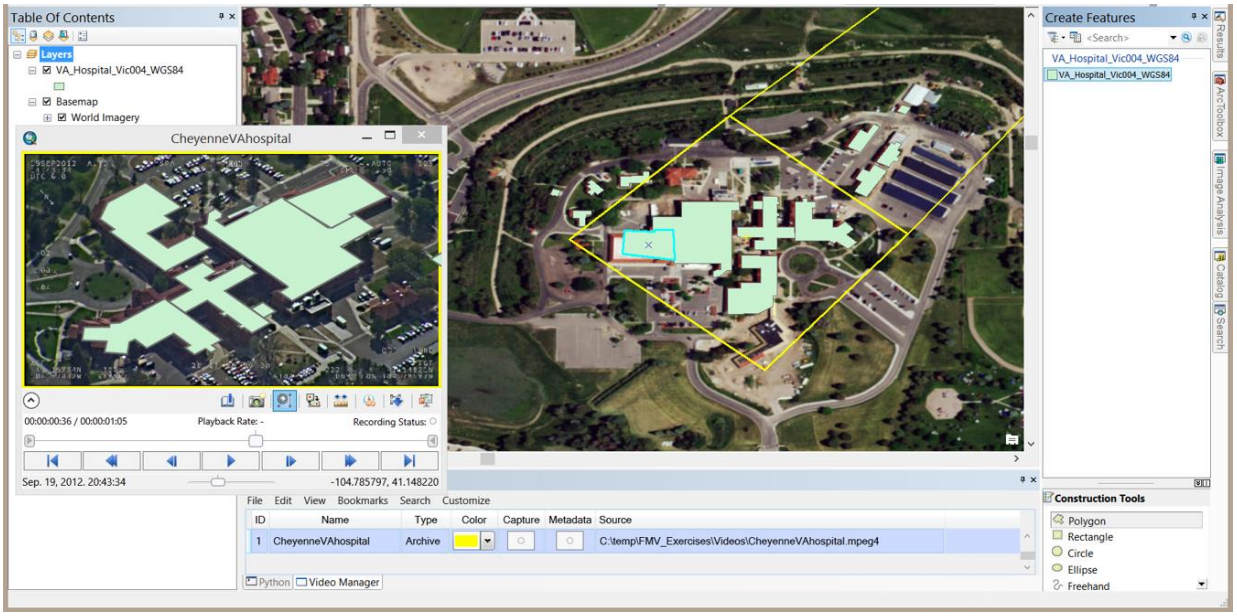
1. Make sure the layer *VA_Hospital_Vic004_WGS84.shp* is turned on and selected in the ToC. In the video player, select the icon, "Start displaying features from the map on the video"

The building features in the map will be displayed in the video player.

Note: Sometimes the features class layer in the video player appears to be offset from the corresponding feature on the map display. This is expected behavior and is due to the high oblique angle and long distance from the sensor and the ground location. At certain times the GIS layer features will be well-registered to the ground feature, other times not so well.

2. Pause the video in the player. Right click on the video in the video manager and choose Manage Bookmarks. Two bookmarks are displayed.
3. Double click on the bookmark named Digitize which will jump you to the bookmark location in the video. Exit the properties dialog.
4. Go the Editor toolbar and open an editing session by choosing "Start Editing". In the Create features pane, select the Building layer, then select "Polygon" as a feature to edit.

5. Digitize the building visible in the Video Player (and missing from the feature class layer and in the ArcMap display), then click the play button on the video which will then display the digitized building in the map.
6. Conversely, digitize a feature in the ArcMap display which will be displayed in the video player when you play the video
7. Stop Editing in the Editor without saving changes



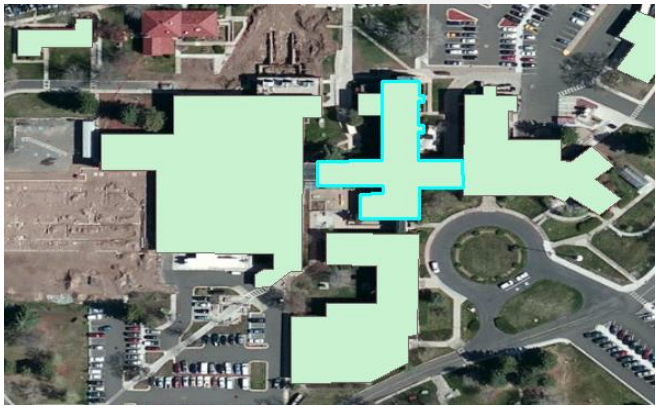
VIDEO SEARCH

As mentioned in the Introduction to Exercise 2, Video Search is a very important capability of the FMV Add-In which enables videos to be searched according to geographic location, a particular location and/or time.

A prerequisite for searching video is that the metadata containing the relevant information for each video file, and portion of a video stream, be extracted from the MISB-compliant video stream. Often this is done ahead of time using the Extract Metadata GP tool which creates feature class layers containing video frame centers, outline and the sensor platform. The search tool combs through this data to extract the portion of each video file that meets the criteria. Extracting the metadata can also be performed right from the video search tool which creates a GP model to extract the metadata from one or more video files. This latter workflow is not addressed in this exercise. Instead, the metadata was already extracted via the Extract Metadata GP tool and stored in an index which will be used in this exercise.

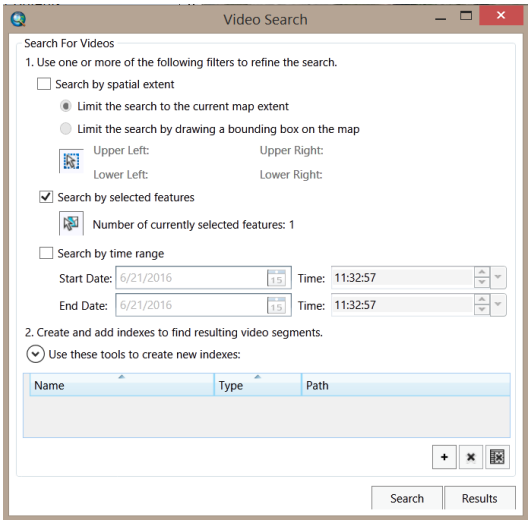
1. Make sure the layer Make sure the layer *VA_Hospital_Vic004_WGS84.shp* is turned on and selected in the ToC.

2. Click on the Select Features icon  in the main menu and select a building.



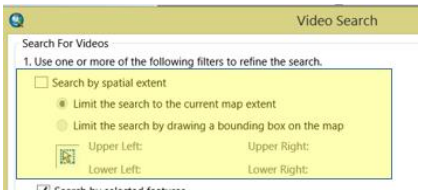
3. Click on the Video Search icon  on the FMV toolbar Which opens the Video Search dialog

The Video Search dialog is comprised of two sections, the search criteria and the files to be searched.

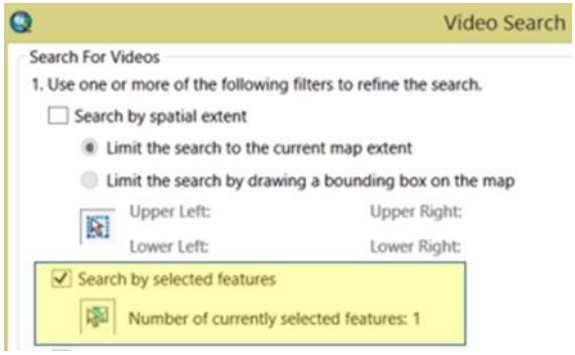


Searches can be by:

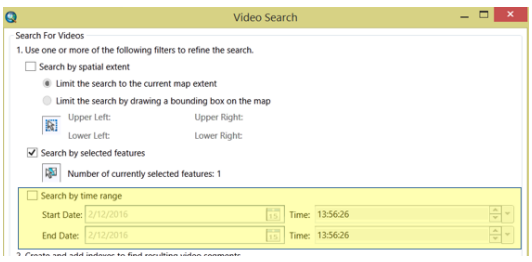
a) Spatial Extent, delimitated by the current map extent or by drawing a bounding box on the map



b) and/or search by a selected feature



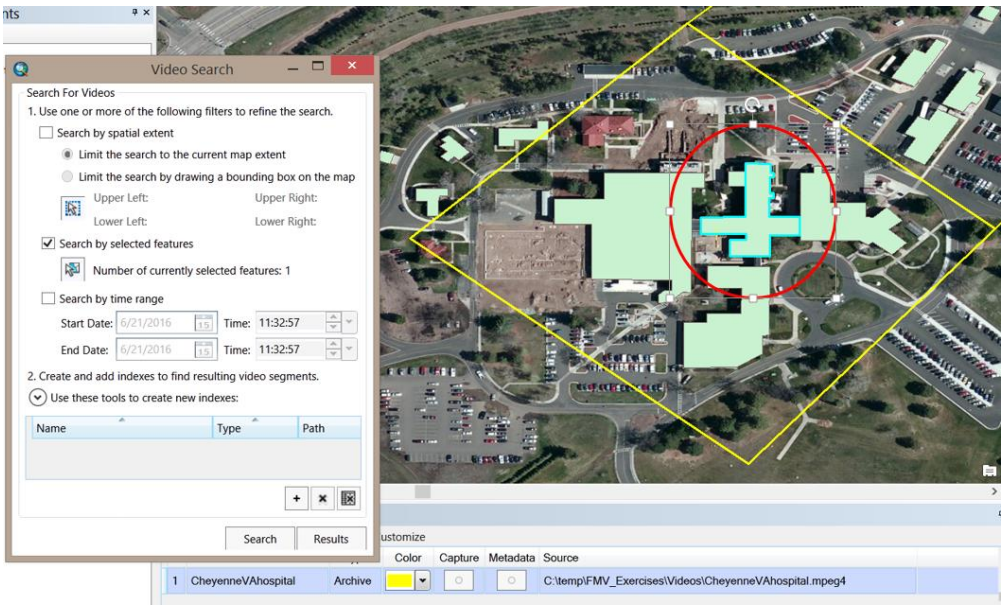
c) and/or time range



In this exercise we will search a number of video files determined by a selected feature.

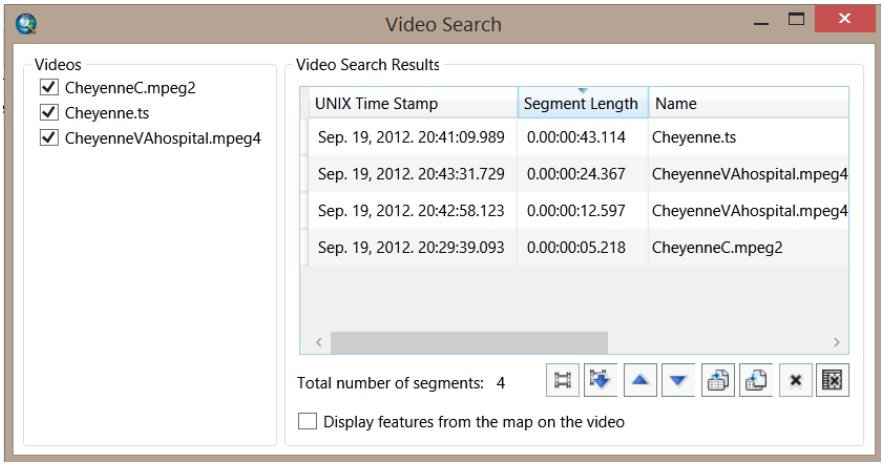
Note that the metadata has been previously extracted by running the Extract Metadata GP tool and saved to a GDB associated with each video.

4. In Catalog, expand FMV_TrainingExercises.gdb to see 2 feature datasets: FMV_metadata and FMV_VideoSearch_Index. Drag FMV_metadata into the display to see the type of metadata extracted from all the video in the Video directory. It is comprised of all the video footprints and center of each video frame, as well as the sensor ground track in all the videos in the directory. This data is what is used in the video search.



Note that a building feature is highlighted in the map and the Search by selected feature option is checked.

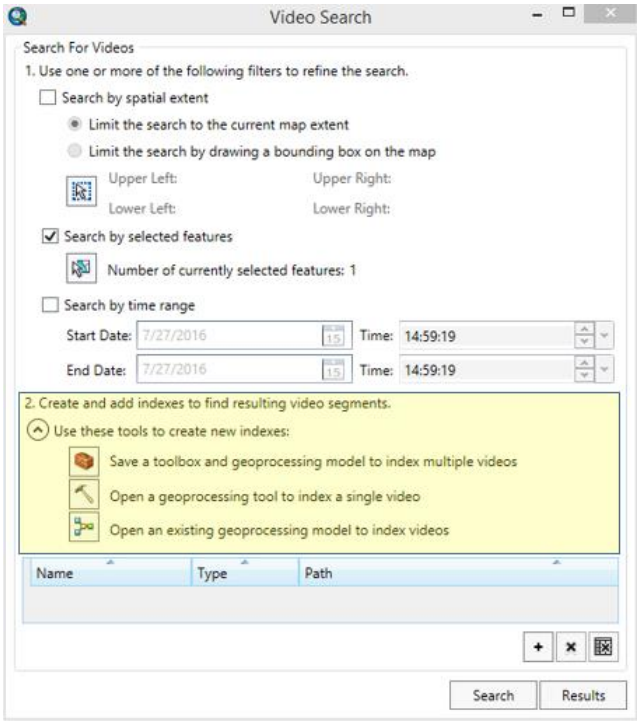
5. At the bottom of the dialog is an Add Data icon. This opens a file browser. Browse to C:\Temp\FMV_Exercises\Data, and choose the *FMV_TrainingExercises.gdb* and select FMV_*VideoSearchIndex* layer. This loaded into the video search dialog
6. Click the Search button. The tool then quickly searches all the FrameOutline layers to identify which video files contain the location of the selected feature, and its position in the video file. This shapefile can also be loaded into ArcMap to display all the video frames on the map.
7. When the search is completed the video search results are presented in a table. The search results table list three videos containing the feature location, and the segments of each video that contains the feature. This can be sorted by the length of the video containing the feature location



8. Double click on the video containing the longest segment. This opens the video player and takes you to the proper position in the video containing the segment with the feature of interest. Click Play on the video player and the segment starts to play.
9. Any of the video segments can be exported as a new video clip by clicking on the "Export the selected segment as a new video clip" icon. 

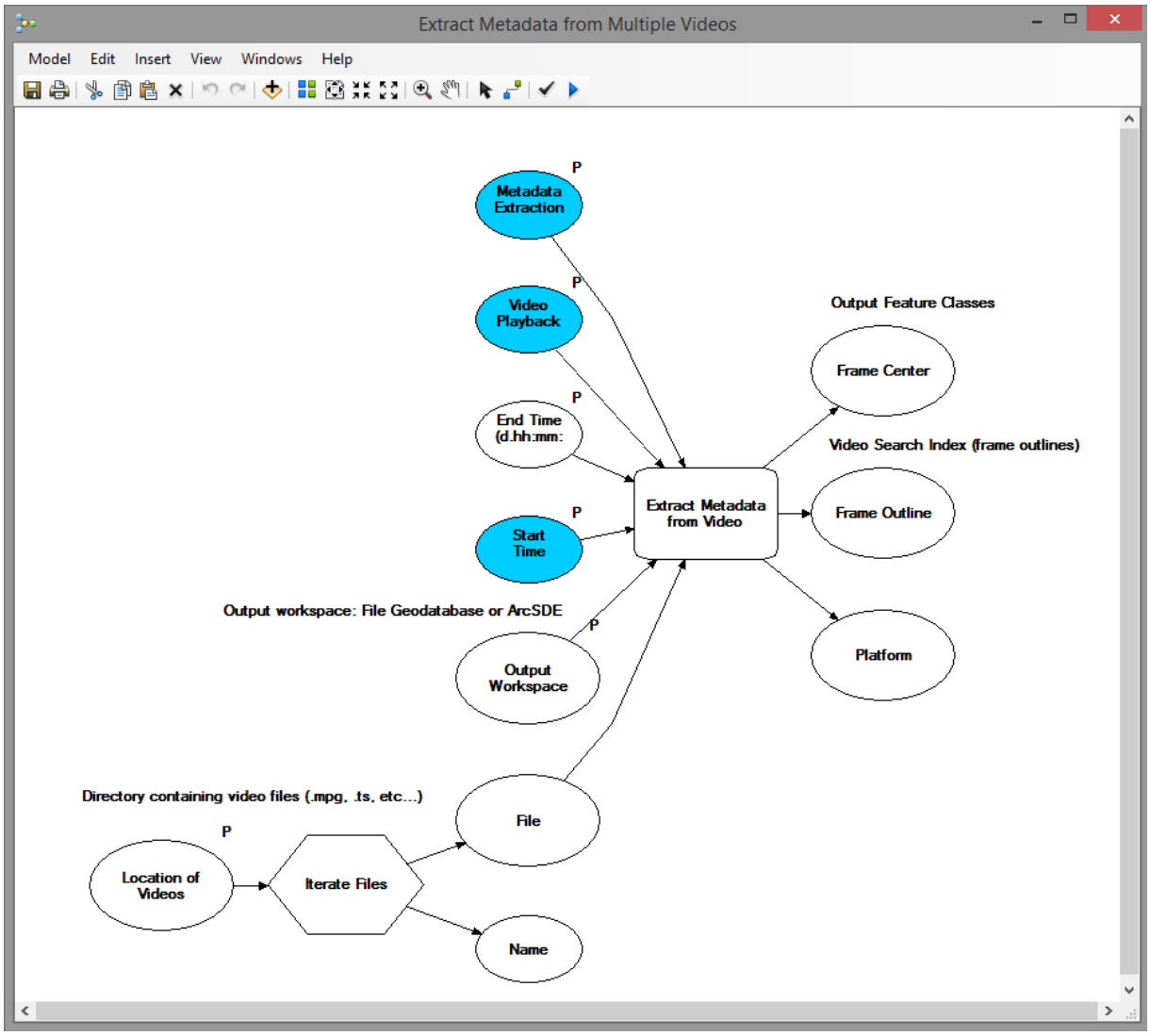
EXTRA CREDIT

The video search exercise above assumes that the metadata from a series of video has already been extracted using the Extract Metadata GP tool. If this has not been done you can easily extract metadata using the Video Search dialog.

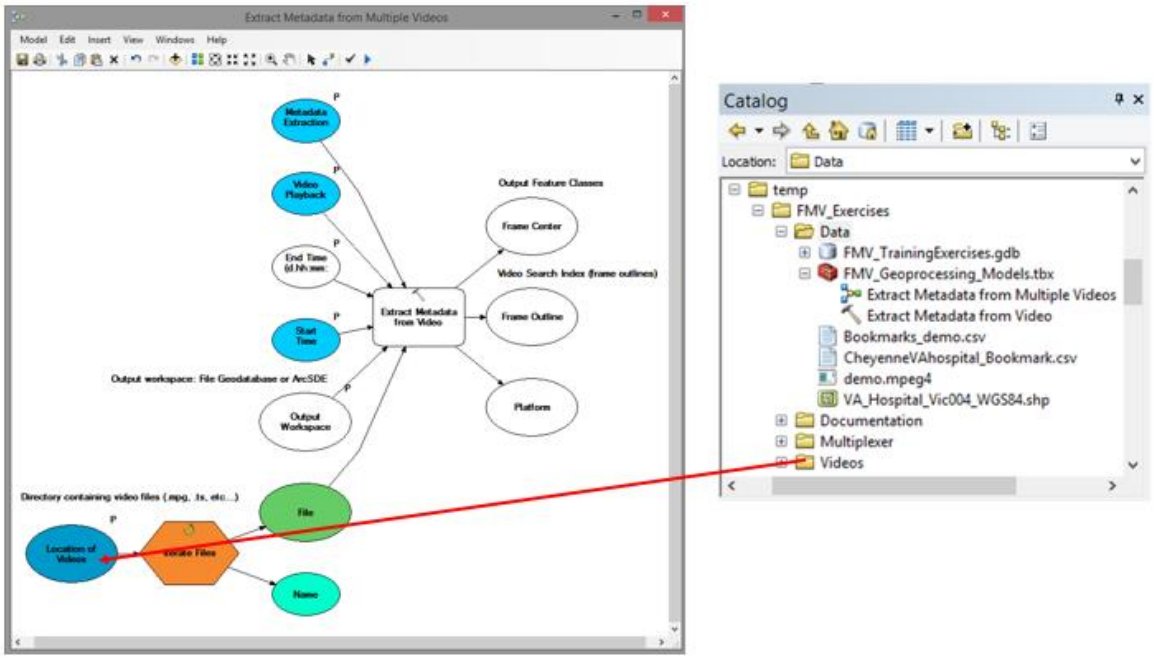


1. In the 2nd part of the Video Search dialog "2. Create and add indexes to find resulting video segments" expand the arrow titled Use these tools to create new indexes.
2. Click on the Save a toolbox and geoprocessing model to index multiple videos icon  and save it to the c:\temp\data directory
3. Refresh the c:\temp\data directory
4. Right click on the …\Data directory in Catalog, select New and create a File Geodatabase. Give it a name such as VideoMetadata.gdb
5. In Catalog expand the toolbox you created to display the GP Model Extract Metadata from Multiple Videos model. Right click and select Edit. The model opens in another window

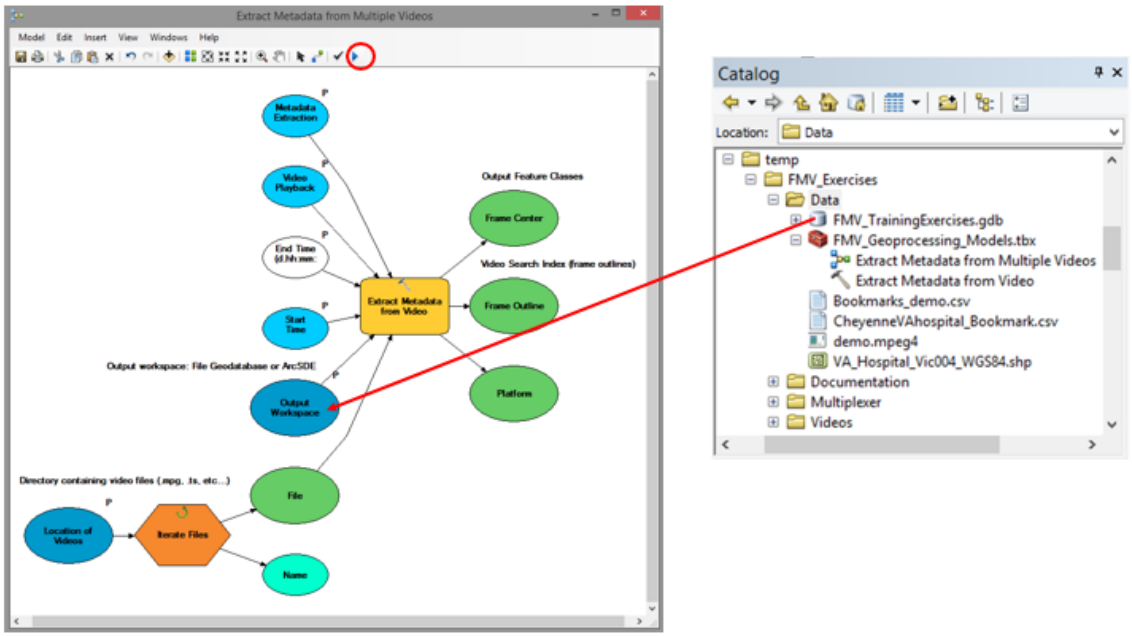
See the Extract Metadata from Multiple Videos model below. Please don't be intimidated by this model; it is simple to set up and use in 2 easy steps!!! See steps below.



1. In Catalog, click on the Video directory and drag/drop it into the Location of Videos parameter in the model. The appropriate model parameters are activated and colored.



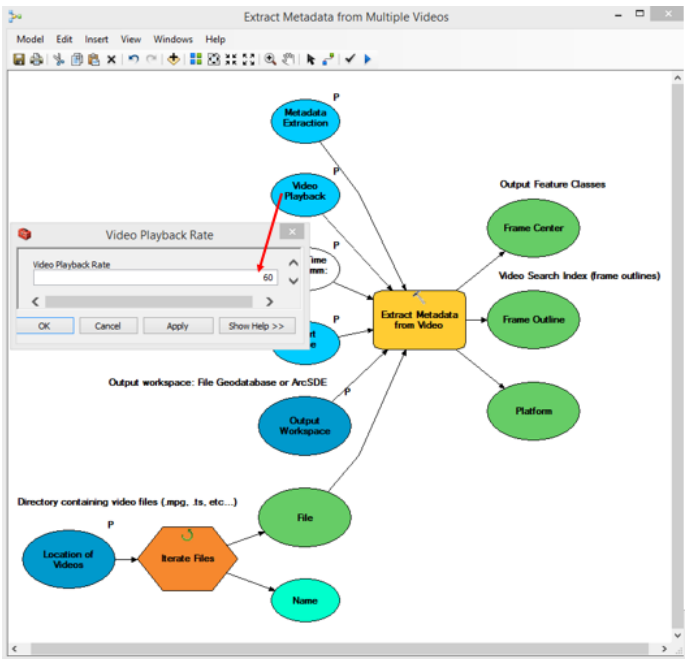
2. Next, in Catalog, click on the file Geodatabase you created and drag/drop it into the Output Workspace parameter in the model. The appropriate model parameters are activated and colored



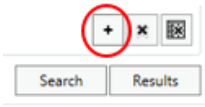
3. Run the model by clicking the Run arrow on the top right of the menu bar of the model window.

Note: It can take some time to extract the metadata from multiple videos. For the purposes of this training exercise it only takes about a minute. If you have many long videos you can speed up the extraction by:

4. Double click on the Video Playback parameter. It opens the dialog with the default value of 20. Change this to 60 or 70 and click Apply. This will greatly increase the extraction rate and rip through videos much faster.



5. To use the extracted metadata in your Video Search, click on the "Add frame outline feature classes and/or feature datasets" and add the



"filename_FrameOutline" feature classes to be searched. The feature class files will be added to the search index. Click on the Search button to search the archive and identify video segments meeting your search criteria.

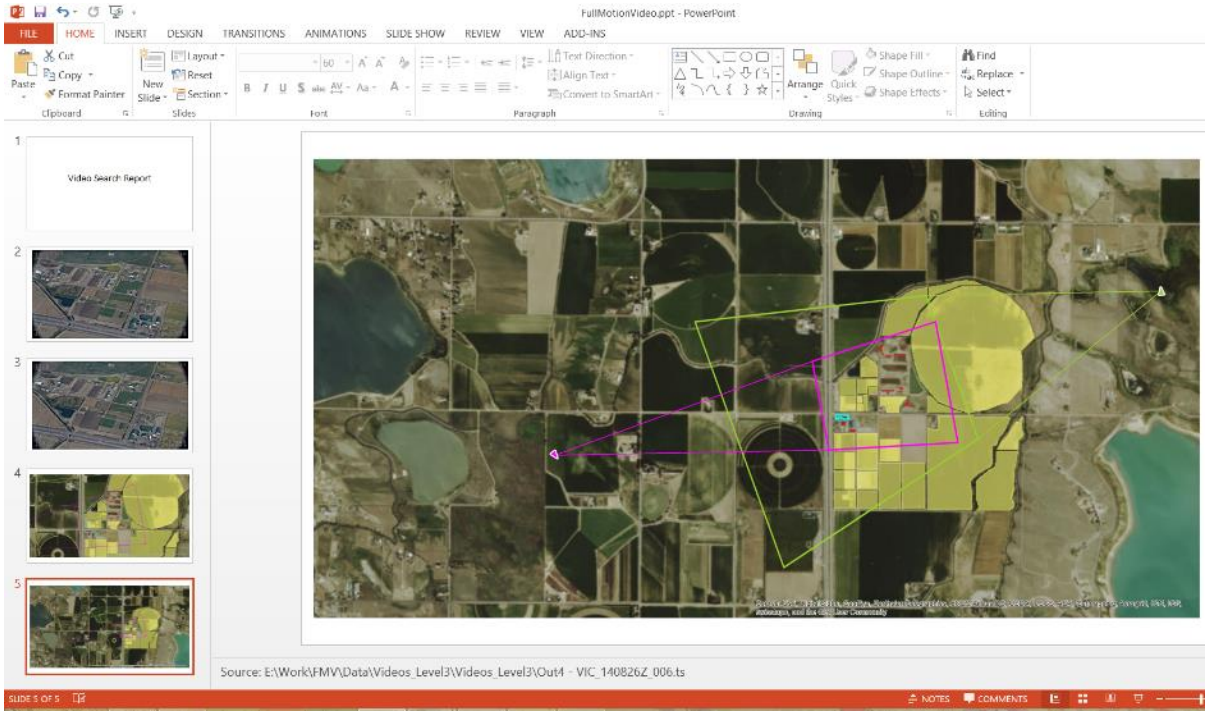
GENERATE A REPORT

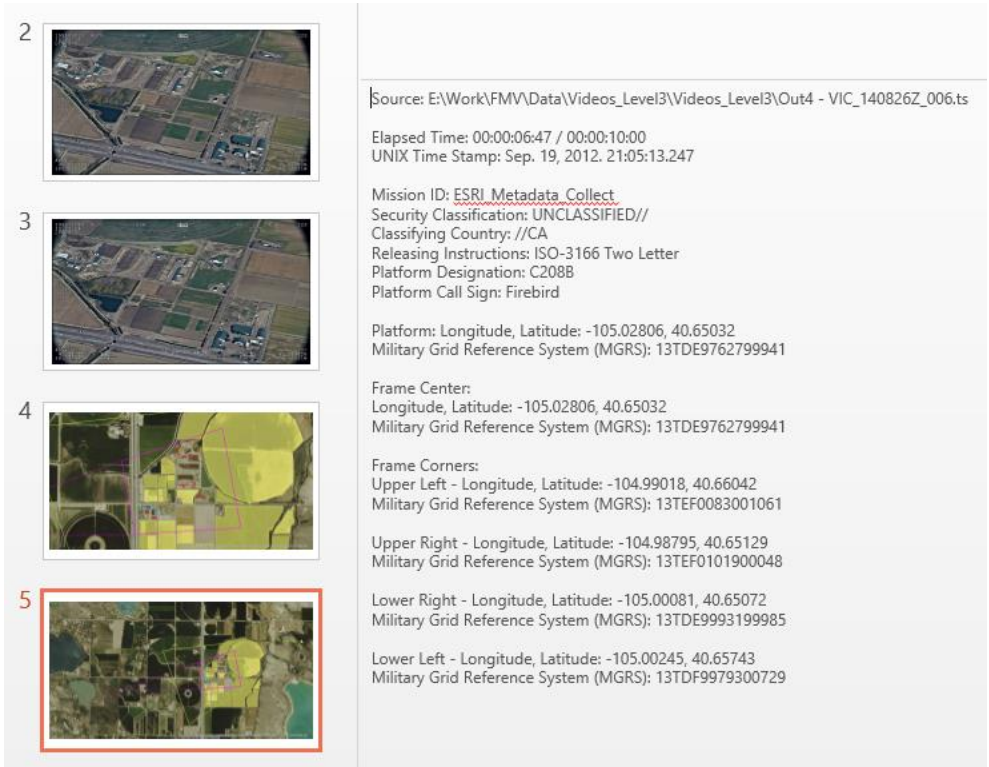
A very useful tool is the automatic generation of a report containing information about the video frame with ONE BUTTON CLICK!!!

1. On the video player, pause the video and zoom into a portion of the video frame of interest. Click the "Create a Powerpoint slide from the current video frame icon. This automatically open a Powerpoint application and populates it with relevant information about the video frame. See example below.

The powerpoint report contains 5 slides:

- A title slide
- The video frame
- The zoomed view of the video frame displayed in the video player
- The overview containing the video footprints from each of the 2 videos, along with the sensor position





Additionally, the metadata pertaining to the video frame is included in the notes section.

SUMMARY OF EXERCISE 2

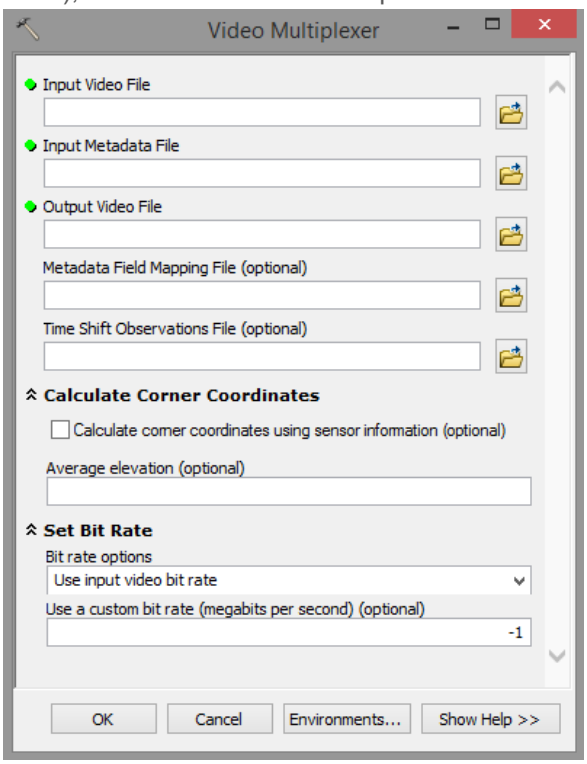
Exercise 2 reviewed three great FMV capabilities; capturing information on either the video or map in a seamless manner, video searching of an archive of videos based on a specific Feature, and automatically generating a Powerpoint report of a specific video frame.

Video Multiplexer GP Tool with Three Scenarios: Exercise 3

The FMV requires that videos be MISB-compliant. Sensor systems that produce MISB-compliant video data are usually very sophisticated and expensive systems. Esri enables users using less expensive commercial off-the-shelf consumer-oriented video capture systems to combine the video data file with the metadata file to create a single MISB-compliant video using the Video Multiplexer GP tool.

DESCRIPTION OF THE VIDEO MULTIPLEXER GP TOOL

The Video Multiplexer GP Tool combines the video file with the metadata file as a CSV (Comma Separated Value); this is often in an Excel spreadsheet. The parameters for the tool include:



Input Video File – The video must be one of the supported file types.

Input Metadata File - This is a CSV file containing metadata about video frames for individual times.

Output Video File - Must be specified with a file suffix, which must match one of the supported file types. The new video file will be the same duration as the original video, but the size will likely be different depending on the bit rate settings (see below).

Metadata Field Mapping File (optional) - This is a CSV (comma separated values) file containing 5 columns and 95 rows, based on a template file included with the original software called Video_Multiplexer_MISB_Field_Mapping_Template.csv.

Time Shift Observations File (Optional) – The time shift observation file is a CSV (comma separated values) containing two columns, the 1st column is the place in the video to start the time shift and the 2nd column is the amount of the time shift.

Note: Sometimes there is a mismatch between the timing of the video and the timing in the metadata. This leads to an apparent time delay between when a ground feature is surrounded by the image footprint and when that ground feature is visible in the video image. If this time shift is observable and consistent the multiplexer can adjust the timing of the metadata to match the video. The time shift observations file

is a CSV (comma separated values) file containing two columns (elapsed time and time shift) and one or two data rows. A template file called Video_Multiplexer_Time_Shift_Template.csv is included with installation software.

Example 1: The video image seems to lag the FMV image footprint by 5 seconds. This can be noticed near the beginning of the video and also near the end. The observation file would contain one line:

0:00, -5 The entire video is shifted 5 seconds.

Example 2: There is a 5 second lag at 0:18 into the video and a 9 second lag at 2:21 into the video. The time observation file would contain two lines.

0:18, -5

2:21, -9

In this case the video is shifted differently at the beginning and end.

Calculate Corner Coordinates - Ideally your metadata contains the coordinates of the frame center and frame corners. If not, these coordinates can be calculated and added to the metadata if certain other metadata fields are present. If this option is selected you must also provide an average ground elevation in the next parameter.

Average Elevation – the average ground elevation. This value can be determined by using the Esri Terrain service from AucGIS Online.

Set Bit Rate - Bit rate is the number of bits that are conveyed or processed per unit of time. A video's bitrate is related to its quality and file size. In general, a lower bitrate will result in a higher rate of compression, require more time to multiplex, and output a smaller file with potentially lower quality. A higher bitrate will typically result in less compression, less processing time, and bigger files with potentially higher quality. When deciding whether to multiplex a video at a lower or higher bitrate, one may consider whether they want to stream and share their videos (lower bit rate) or archive their videos at maximum quality (higher bit rate).

There are four different ways to enter bitrate for multiplexing:

1. Custom bit rate - Manually input a bit rate value into the Use a custom bit rate field.
2. Use input video bit rate - Use the same bit rate as the Input Video File.
3. Use video dimensions - Use the Input Video File's height and width to estimate the new bit rate. Values calcuated this way will tend towards lower bit rates relative to the original video. This method may be more appropriate for streaming or sharing a video after multiplexing.
4. Low, medium, and high action level - These values help to automatically calculate an optimized bit rate based on the Kush Gauge equation. The Kush Gauge equation can be helpful if you plan to stream or share your video after multiplexing and you don't know your user's exact bandwidth. Low, medium, and high action levels refer to how much things “move” within a video and help to

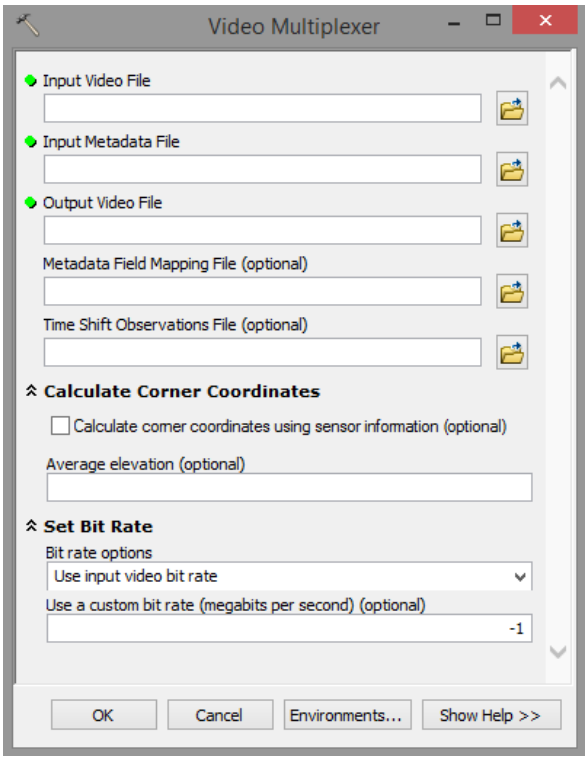
calculate an optimized bit rate. For example, a video of a car race would have a high action level, a person walking may have a medium level, and a static façade of a building might be low.

Use a Custom Bit Rate - When Custom bit rate is selected under Bit rate options, a bit rate in megabits per second (mbps) must be entered. This bit rate must be equal to or greater than 1.5 mbps. A value of -1 indicates that the custom bit rate will be ignored during processing.

DESCRIPTION OF THE EXERCISE

The power point presentation in the C:\Temp|FMV_Exercises\Multiplexer directory gives an overview of the Video Multiplexer tool and describes the three scenarios that will be tested. It can provide more insight into why these steps are taken. The testing will use the following files:

- Input video file (all scenarios) : 01425001.mpeg
- Input Metadata CSV file (all scenarios) : 01425001.csv
- Metadata Field Mapping file (scenario 2) : 01425001_MISB_Field_mapping.csv
- Time Shift Observations file (scenario 3) : 01425001_timeShifts.csv



Start the Video Multiplexer GP Tool (in the Full Motion Video Toolbox) and become familiar with the parameters. Run the tool three times with different settings as described below. Use the Video Player and metadata viewer to examine the original video and the three output video files to ensure they have the correct results. The original video will not have any metadata, and nothing will show on the ArcMap display while it is running.

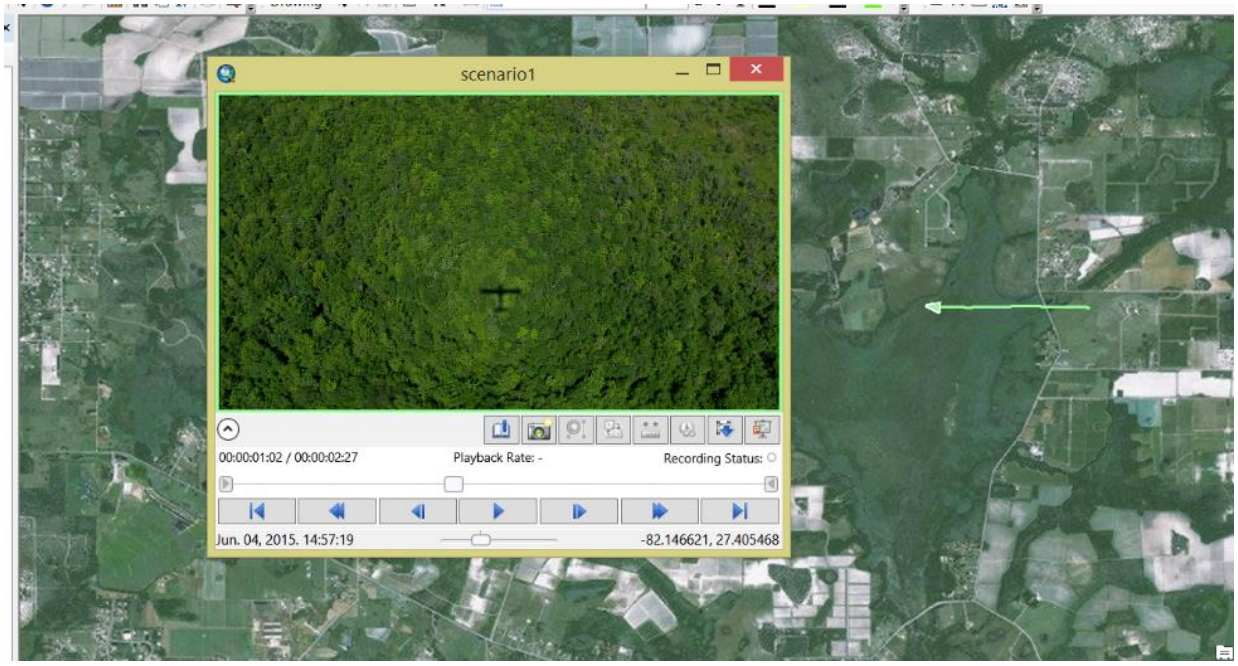
- Specify the input video file above for all 3 scenarios
- Specify the metadata CSV file above for all 3 scenarios
- Specify a different output file for each scenario
    - First scenario “01425001a.ts”, second scenario “01425001b.ts”, third “01425001c.ts”

SCENARIO 1

Run the Video Multiplexing without calculating the corners of the video frame.

1. Open ArcMap and load the video 01425001.mpeg into the video manager

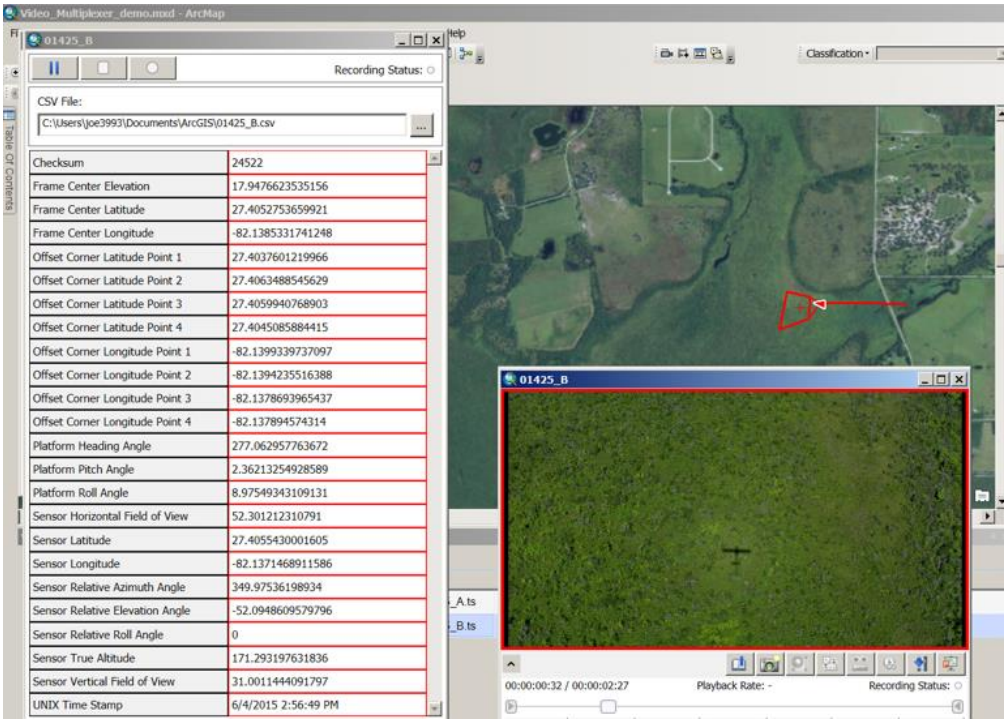
2. Copy the video. Right click on the video in the video manager and select Metadata. Nothing will display since the video does not contain any metadata.
3. Run the Video Multiplexer GP tool after specifying the output file 01425001a.ts. It will take about 12 minutes to multiplex the video.
4. Load the output file into the video manager when it has completed.
5. Play the video
6. Right click on the video in the Video Manager and select Metadata. The new video will have some metadata (like the sensor location) but not the frame corner coordinates. The aircraft track will display but not the image frame. If so the GP Tool has run correctly.



SCENARIO 2

Run the Video Multiplexing tool and calculate the corners of each video frame.

1. Specify the MISB field mapping file above.
2. Select the “Calculate corner coordinates” box and set the average elevation to 18.
3. Run the tool after specifying the output 01425001b.ts. Again this will take about 12 minutes.
4. Load the updated video and view the metadata by right clicking the video in the player, select Metadata. This video will have some additional metadata (frame corners and center). The aircraft track will be displayed as well as the image footprint.



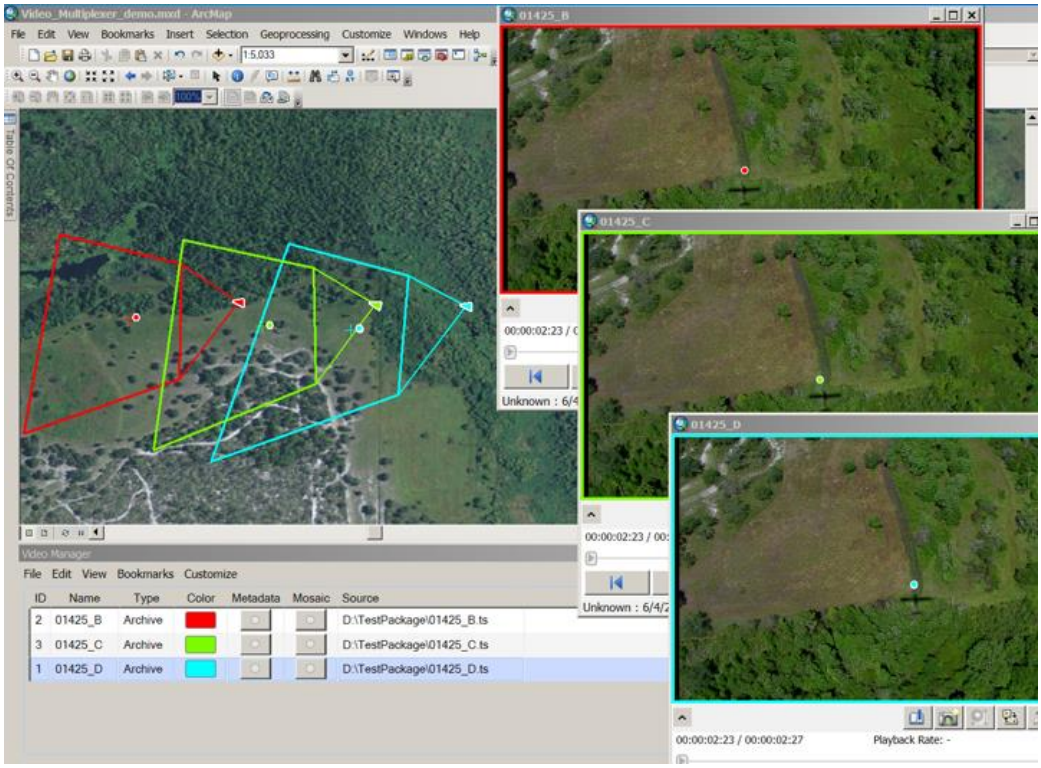
SCENARIO 3

Run the Video Multiplexing tool and adjust for a time shift between the video and the metadata.

1. Select the “Calculate corner coordinates” box and set the average elevation to 18.
2. Specify the Time Shift Observations file above.
3. Run the tool after specifying the output 01425001c.ts and load the result.

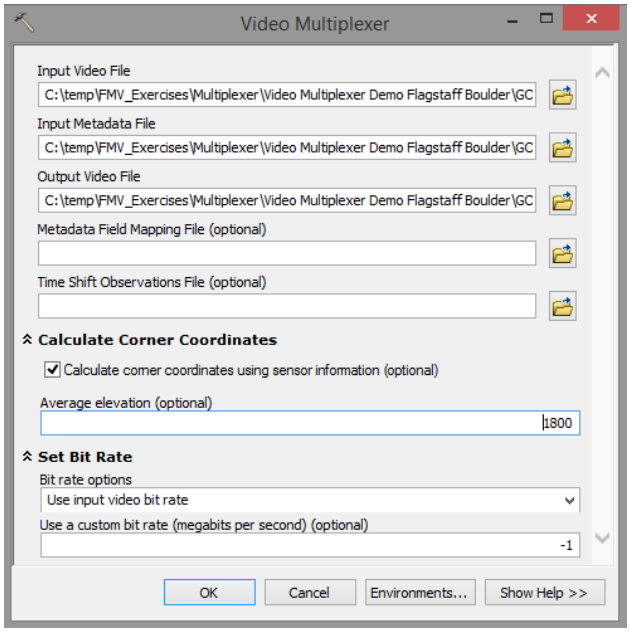
The video will be similar to the previous results, but the timing will be different. Pause at about 0:13 into the video. If the video frame shows a road in the video player corresponding to the road in the map the multiplexer has worked correctly.

See comparison of the three scenarios below showing the offsets due to differences in the synchronization of the metadata and video data.



BONUS EXERCISE

This exercise demonstrates that MISB-Compliant videos can be easily created using commercial off-the-shelf equipment. Esri has existing users that create MISB-compliant videos using a system comprised of a quadcopter drone, video camera, GPS and IMU for less than $2,500.



This case used a GoPro video camera (Black model), a GPS coordinate and compass direction to create the csv file used to multiplex with the video.

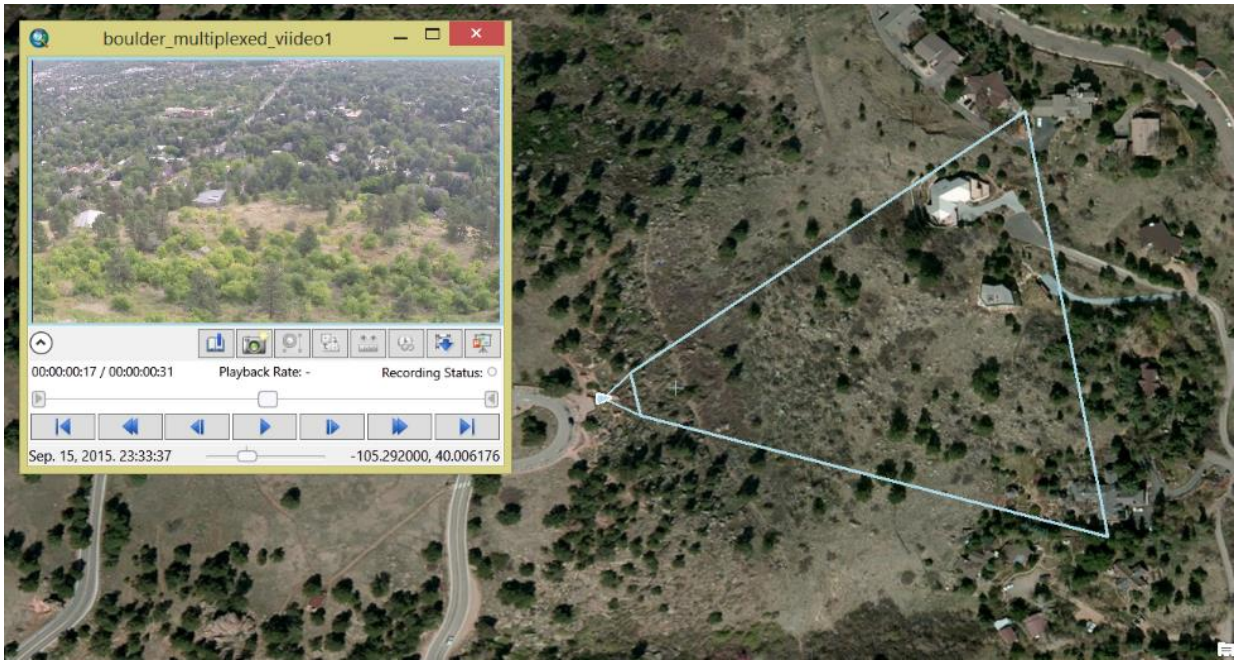
Unzip the files from Video Multiplexer Demo Flagstaff Boulder.zip.

Use GOPRO2053.MP4 as the input video file, with GOPRO 2053 Boulder.csv as the input

metadata csv file. Specify GOPRO_out.ts as the output video file and an average elevation of 1800 meters.

If you zoom to the resulting image frame it should be located in Colorado.

Note: Excel insists on representing large numbers using scientific notation. You may have to open the csv file and specify the format of the Time Stamp column to be Integer with no decimal places. Then resave



FMV TRAINING EXERCISES

SUMMARY

These exercises cover the range of FMV capability that is commonly utilized by users in their day-to-day operations. The topics covered include the operation of the video player, the Video Manager, display and editing of a feature class on both the map and video, video searching, generating a report for a video frame of interest and the video multiplexer tool. These exercises provide a solid foundation for generating relevant FMV product demos to excite and motivate customers to utilize and leverage the FMV tools to accomplish their day-to-day work better, faster and more efficiently.

For more information about the FMV Add-In capabilities please refer to the FMV User's Manual included in this download under …\Documents, as well as the FMV landing page website www.esri.com/FMV and GeoNet https://geonet.esri.com/search.jspa?q=fmv