

VERSION 1.2

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3DR SOLO/ESRI FMV

CONFIGURING THE 3DR SOLO FOR ESRI FULL MOTION VIDEO

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INTRODUCTION

This document outlines the process of collecting video and metadata with a 3DR Solo for use in Esri Full Motion Video (FMV). In order to use Esri FMV, a video must be [MISB](#) compliant. Since the 3DR Solo doesn't collect MISB compliant data, we use an Esri geoprocessing tool called the Video Multiplexer to combine the video file with position and orientation metadata into a MISB-compliant file ready for use in the Esri FMV Add-in and GP Tools.

For more information about MISB, go to the [MISB zipped publications](#). Download the latest MISB documents and unzip the files. Look for a document called ST0601.9.pdf. This document has very detailed information about every metadata field supported by Esri FMV.

If at any time you need further FMV support, please go to www.esri.com/fmv or if you need 3DR support, go to [3DR.com Solo Support](#)

SETTING UP YOUR ENVIRONMENT

CONFIGURE 3DR SOLO WIFI

Ensure that your Solo and its associated controller have a secure Wi-Fi network and that they can see each other within the network. If you need instructions on how to do this go to [3DR Connecting Solo Wi-Fi](#).

IMPORTANT: Check to make sure that your Solo is configured with firmware version 2.4.0 or higher. Also, note that the 3DR/FMV python files and metadata collection methods outlined here also support 3DR Site Scan™. Ensure the proper version of the python files are utilized with the 3DR Solo 2.4.0 or Site Scan™ versions.

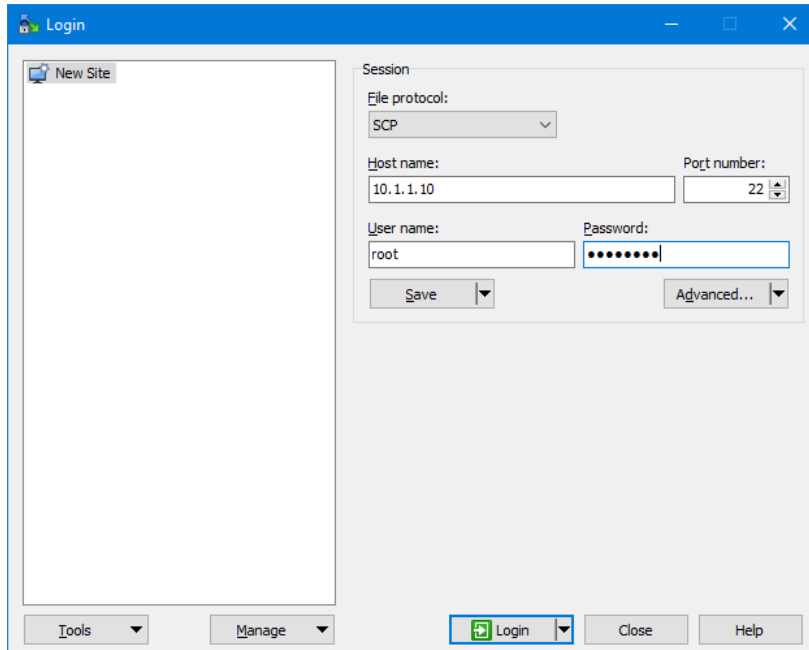
DOWNLOAD WINSCP AND TEST CONNECTIONS

WinSCP (Windows Secure Copy) is an open-source client for Microsoft Windows that's used for secure file transfer between two computers. In this case, it will be used to transfer files back and forth between your Solo and your PC.

The following information is from the [3DR advanced logs](#) page.

1. Download and install WinSCP from [here](#).
2. Turn on the Solo Controller and Solo and connect your PC to the Solo WiFi network. The default name of the Solo Controller network is "SoloLink" and the default network password is "sololink". You may have changed these during your initial setup.
3. Open *WinSCP* and select **New Site**:
4. Enter the following site information and then select **Login**:
 - **File protocol:** SCP
 - **Solo IP Address:** 10.1.1.10
 - **Port number:** 22
 - **User name:** root

- **Password:** TjSDBkAu



Note: If you ever need to connect to the Solo controller, all of the WinSCP inputs are the same, except the Host name IP address is 10.1.1.1 and not 10.1.1.10.

PYTHON FILES

Any time the propellers are spinning and you start recording a new video, a new Esri FMV-specific log file will be created on the Solo and the Solo will start to record sensor data. When you stop recording or land, the video recording and FMV logging will automatically stop. The Python files included in the *.zip archive containing this document will temporally sync your camera and Solo sensors and then format the Solo telemetry metadata into the Esri FMV format.

You will find two zip archives with Python files built for different versions of firmware on the Solo. The zip archives are labeled based on the Solo firmware version – e.g. for Solo 2.4.0 use *3DR_FM_VLogger_Python_Files_v2.4.0.zip*. If you're a Site Scan customer with 3.x.x (GoPro), use *3DR_FM_VLogger_Python_Files_v3.x.x.zip*. Within these archives you'll find three Python scripts: *fileappManager.py*, *FMVLogger.py*, and *shotManager.py*.

IMPORTANT: If you are not using Solo firmware version 2.4.0 or you've installed 3DR updates, for example 2.4.1, you may need to edit the *appManager.py* and *shotManager.py* files yourself. This is done so that none of the 3DR updates are missed and the FMV functionality is there. To do this, download *appManager.py* from the Solo using WinSCP and add the lines shown below as outlined in the 2.4.0 script, where it appears on line 223. Once you've edited the file, upload it back to the Solo following the instructions in the section titled 'TRANSFER THE PYTHON FILES TO YOUR 3DR SOLO'.

FOR APPMANAGER.PY

```
# Gopromanager handles these messages
self.shotMgr.fmvLogger.handlePacket(packetType, packetValue)
```

FOR SHOTMANAGER.PY

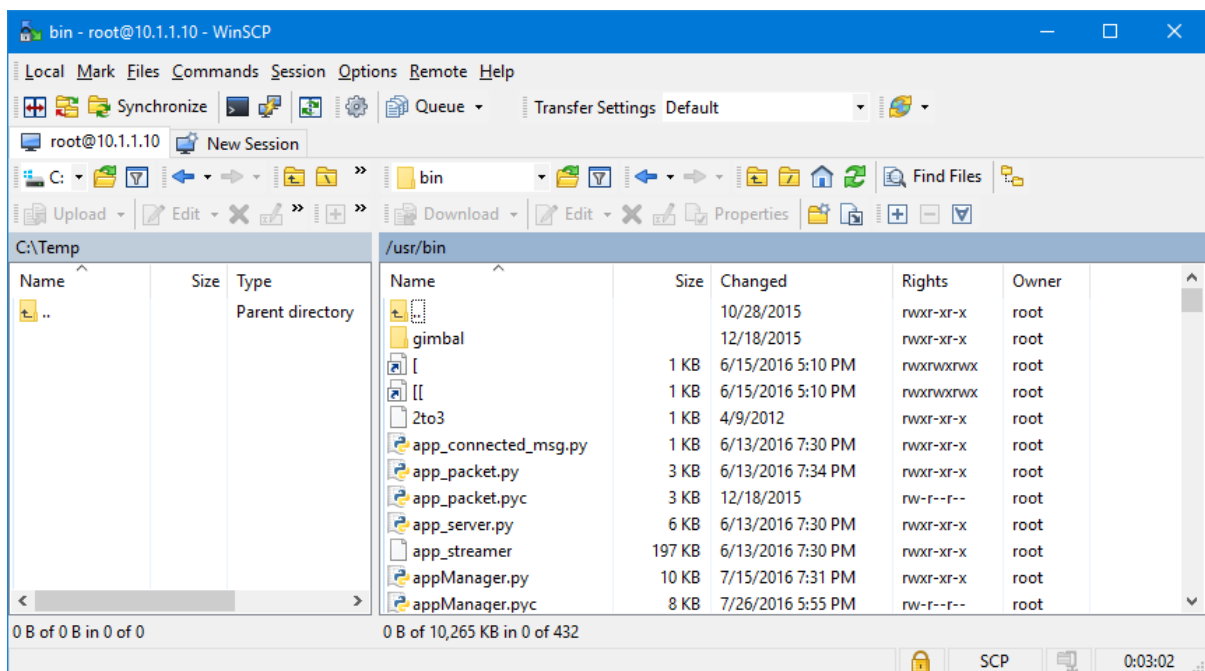
```
# Loggers imports
import shotLogger
import FMVLogger# Initialize FMV Logger

# Initialize FMV Logger
self.fmvLogger = FMVLogger.FMVLogger(self)
```

TRANSFER THE PYTHON FILES TO YOUR 3DR SOLO

In this step, you will transfer the appManager.py, FMVLogger.py, and shotManager.py files from your PC to the Solo.

1. From your PC, close any existing Wi-Fi connections.
2. Turn on both the 3DR Solo and its associated controller.
3. Establish a connection with your PC through the 3DR Solo's Wi-Fi network.
4. From your PC, open WinSCP.exe and establish a connection with the Solo at IP address 10.1.1.10 (for more information see the WinSCP login instructions at [3DR advanced logs](#)).



5. Using WinSCP, make backup copies of the following files to the Solo's /usr/bin directory: appManager.py, FMVLogger.py, and shotManager.py. Once you are sure that you have backups saved of the original files, copy

the files with these names (provided within the 3DR_FM_V_Python_Files.zip file in the previous step) to the Solo's /usr/bin directory.

6. Use WinSCP to remove the following *.pyc files from the Solo's /usr/bin directory: appManager.pyc, FMVLogger.pyc, and shotManager.pyc. These *.pyc files are pre-compiled versions of the existing Python scripts and will be re-created the next time the Solo is launched. They need to be removed to run the new Python scripts.
7. Disconnect your PC from the Solo Wi-Fi network.

FLYING YOUR MISSION AND COLLECTING VIDEOS AND METADATA

CONFIGURE THE GOPRO WITH THE RECOMMENDED 3DR SETTINGS

Resolution: 1080p or 2.7K (1080 is recommended)

Field of View: Medium

Low Light: Off

Spot Meter: Off

Protune: On (if available)

White Balance: Auto

Color: GOPRO

ISO: 400

Sharpness: Medium

EV Comp: 0

Note: The platform heading is not calibrated if the camera is on and recording, but the propellers are not spinning. As a result, if the camera recording is initiated before propellers begin spinning, the platform heading values may be inaccurate.

PLAN YOUR MISSION AND DATA COLLECTION

Plan your mission and fly your Solo to collect your videos and their associated metadata. The Python files uploaded in the previous step will sync the camera and metadata collection systems and create one new metadata file for each new video. These videos and metadata files will be used in following steps to create a new combined, or multiplexed, version of the video. This new version of the video will contain both the video and the metadata in a fully [MISB](#)-compliant format ready for use in Esri FMV.

FLIGHT RECOMMENDATIONS

- Fly slowly and keep the drone stable.
- You can point the camera straight down (nadir) to minimize spatial distortion.

SAVING AND CONFIGURING YOUR VIDEOS AND METADATA

EXPORT YOUR VIDEOS FROM THE GOPRO

Follow these steps to download your videos from the GoPro camera. The GoPro uses a fisheye lens, which introduces a substantial degree of distortion in all videos. That distortion will in turn reduce the spatial accuracy of the video if it is not corrected. These steps must be followed in order to correctly remove this fisheye effect. See the following link for more information: [How can I remove the distortion fisheye effect in GoPro studio?](#)

Begin by downloading the GoProStudio application needed to perform the fisheye removal from <https://shop.gopro.com/softwareandapp>. Install the GoPro software, then continue below.

1. Connect the GoPro camera to your PC.
2. Open the GoPro Studio application and select "Import New Files." **IMPORTANT:** The video file must be imported directly from the GoPro camera with the original file name. If the file is moved or the name is changed, the fisheye effect will not be removed.
3. Navigate to the GoPro camera location and select your video. Then select "Advanced Settings".
4. In Advanced Settings, check the "Remove Fisheye" option. Select OK.
5. Select the "Add Clip To Conversion List" button and then select the "Convert All" button. When the conversion is complete, select "Proceed to Step 2." If prompted to choose an Edit Template, select Cancel to exit that dialog,
6. Select and drag the video from the left panel to the video timeline, labeled "Drag Video Here." Then select "Step 3 EXPORT" to proceed to the export step to save the clip to a new .MP4 file.
7. Create a custom export configuration, based on the recommended 3DR GoPro settings, for optimal performance in Esri FMV; otherwise, select or configure your own. Then select the Export button and save the file to your PC.
 - **Export Type: Custom**
 - Format: H.264 (MP4)
 - Frame Size: Full HD 16:9 (1920 x 1080)
 - Frame Rate: 29.97 (30p)
 - Bitrate (Mbps): 10

COPY THE FMV METADATA LOG FILES FROM THE SOLO TO YOUR PC

1. Turn on the Solo controller. Turn on the Solo and if you have a gimbal, connect the GoPro camera.
2. From your PC, connect to the Solo Wi-Fi network.
3. Use WinSCP and enter the following site information, then select **Login**:
 - **File protocol:** SCP
 - **Solo IP Address:** 10.1.1.10
 - **Port number:** 22
 - **User name:** root
 - **Password:** TjSDBkAu
4. Through WinSCP, browse to the Solo and navigate to /log/fmv/fmvLog_<date_time>.txt

5. Using WinSCP, select this file and drag and drop it to a convenient location on your PC. The <date_time> in the example file name will have an actual date and time separated by underscores (e.g. fmvLog_2016_07_26_20_45_59.txt).
6. After copying the FMV log file to your PC, you may safely delete it from the Solo.
7. Disconnect your PC from WinSCP and the Solo Wi-Fi network.
8. Turn off the Solo and the Solo controller.

This log file will provide the key data for the metadata file you must prepare for input into the **FMV Video Multiplexer** geoprocessing tool.

PREPARE YOUR METADATA FILE FOR INPUT TO THE FMV VIDEO MULTIPLEXER

Detailed instructions for preparing metadata and then running the Multiplexer are included in the FMV User Manual, available at <http://esriurl.com/FMV132Manual>. A few notes specific to the 3DRobotics Solo and GoPro video camera are included below.

SPECIFY THE SENSOR FIELD OF VIEW (FOV)

The metadata file will already have a field for data values labeled **HorizontalFOV**. You will need to add another column and label it **VerticalFOV**.

For the GoPro in **Wide FOV** mode, enter an estimated value for **VerticalFOV** of 50 degrees for all records (this value works relatively well presuming the fisheye effect has been removed).

Correct the value for **HorizontalFOV** to 80 degrees for all records – the original metadata shows 118, but that was before removal of the fisheye.

Note that these FOV values have not been precisely determined, but are merely an estimate to provide a recommended starting point. If your objective is to achieve the highest possible accuracy, you will need to determine these values independently. Also note that this workflow has not been tested to determine the FOV values for **Medium FOV** or **Narrow FOV** modes of the GoPro, but you should be able to estimate FOV values based on your data.

FORMAT THE SENSOR ALTITUDE

SensorAltitude on the Solo is reported as a value relative to the launch height, whereas the MISB specification defines sensor altitude as the altitude of the sensor Above Mean Sea Level (AMSL – also known as orthometric height). Note that the FMV Video Multiplexer requires **SensorAltitude** to be measured as height above ground, so your table of metadata may not need to be adjusted, depending on the terrain of your project area. Refer to the section titled “SensorAltitude” in the FMV User Manual.

There are two cases:

- If your project area has minimal terrain variability (e.g. minimum to maximum elevation values do not vary more than approximately 20% of your flying height above ground), OR if the accuracy of your video footprint is not extremely important, you will not need to modify your **SensorAltitude** values.
- On the other hand, if your project area includes terrain that varies more than approximately 20% of your flying height above ground (or a different maximum threshold determined by your organization), the altitude values in your Solo metadata file must be converted to represent height above ground prior to

running the Multiplexer. See detailed instructions in the FMV User Manual for sampling ground elevation values and adjusting your metadata .

SAVE YOUR METADATA FILE AS .CSV FORMAT

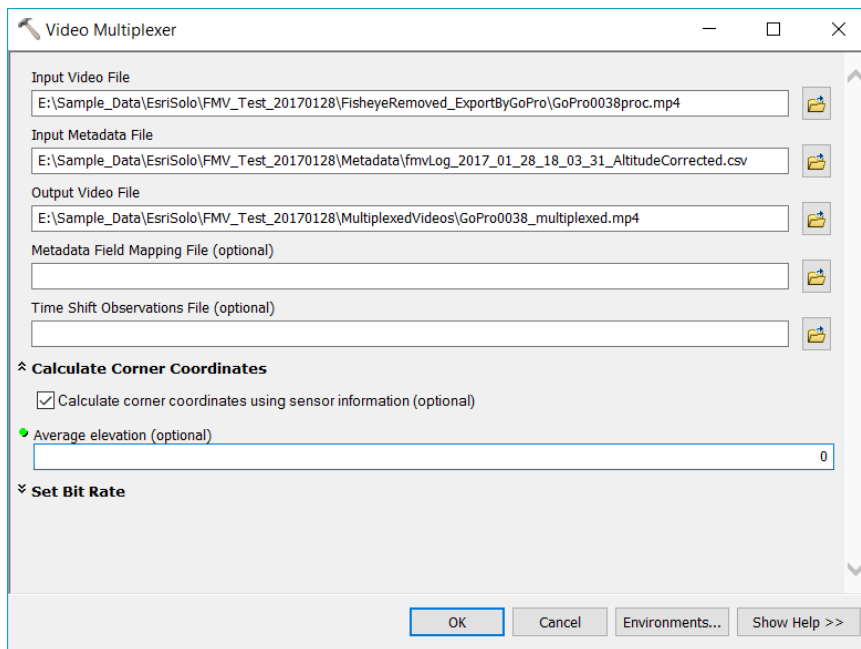
The Esri **FMV Video Multiplexer** GP tool requires the video metadata to be in the .CSV format. As the last step before running the Multiplexer, you will need to save the metadata file as *.CSV, making sure that you have replaced any formulas with values, and that the UNIX Time Stamp column is properly formatted as “number” with no decimal places. At this point you can proceed to running the Multiplexer.

VIDEO MULTIPLEXER GEOPROCESSING TOOL

MULTIPLEXING YOUR VIDEOS AND METADATA

Follow these steps to combine your video and metadata into a new MISB-compliant video.

1. Make sure you have the Esri FMV GP tools installed. If you don't have the tools installed, go to www.esri.com/fmv and scroll to the bottom for ordering instructions.
2. In ArcMap, open the Catalog and then navigate to Toolboxes > System Toolboxes > Full Motion Video Tools.tbx > Video Multiplexer GP tool
3. Open the Video Multiplexer GP tool and input the required files and selections as shown in the below example.
 - a. The input video file should be the version that has been corrected for fisheye distortion
 - b. The input metadata file will be the *.CSV described in the section above.
 - c. Be sure to select the “Calculate corner coordinates using sensor information” checkbox.
 - d. Enter zero as the Average elevation.
 - e. Run the tool to create a new video file.



PLAYING THE VIDEO IN FMV FOR ARCGIS

A correctly multiplexed video will display the footprint of the video frame, the sensor ground track, the frame center, and the sensor with heading on the map.

The metadata associated with each video frame can be displayed by right-clicking on the video player and selecting 'Metadata...'; as shown in the example below.

For additional information on Esri FMV, see the help document included with the Add-in and GP tool installation, or download directly from <http://esriurl.com/FMV132Manual>.

