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Bringing Airborne Video Into ArcGIS

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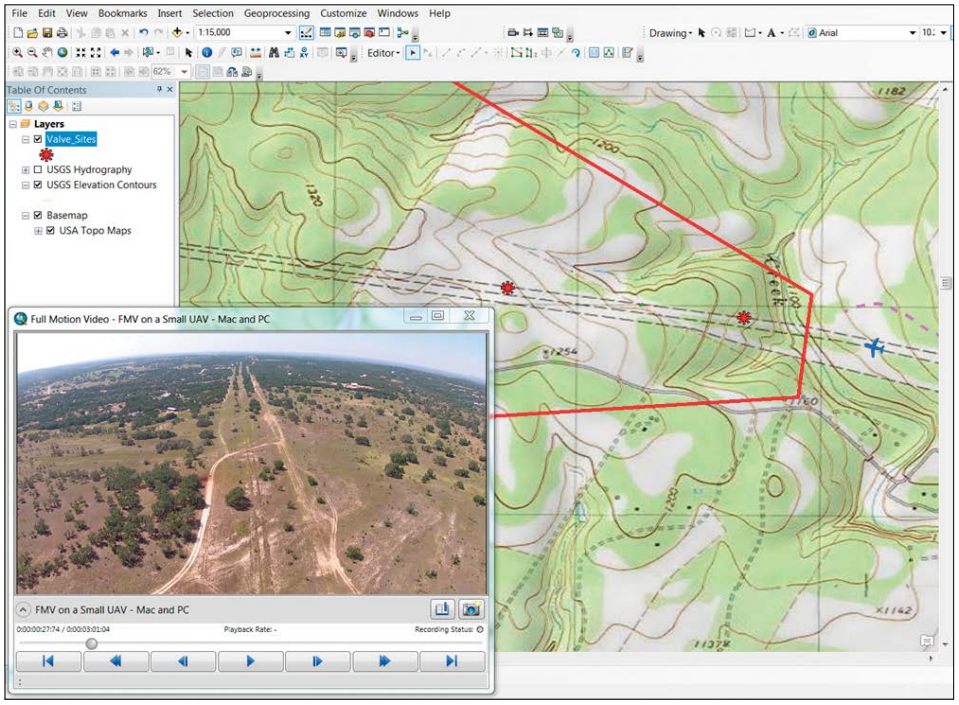
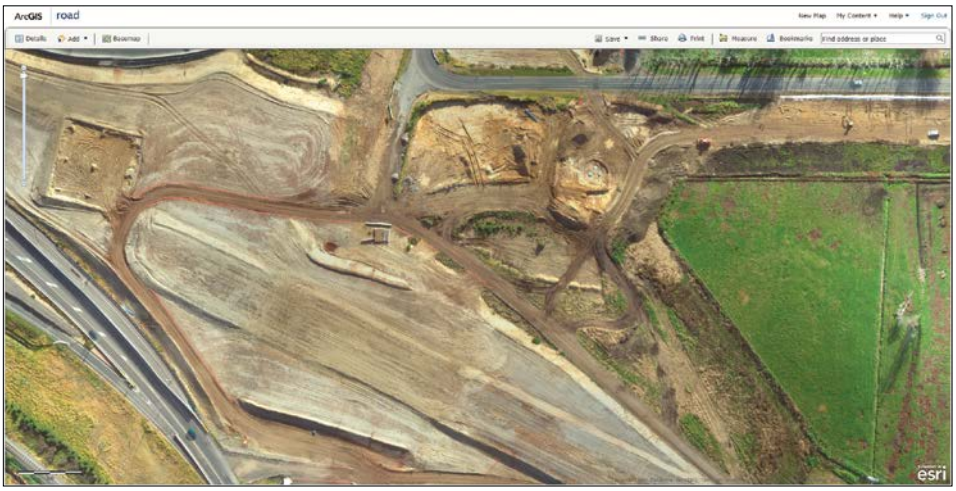
Full-motion video (FMV) refers to the capture of airborne video in a data format that includes metadata about the aircraft's altitude, attitude, GPS location, and the corresponding orientation information about the camera sensor. Given these basic geometric parameters, GIS properly georeferences and displays the imagery on a map. Esri recently released its FMV Toolbar for ArcGIS, which allows video to be directly incorporated into GIS. Flight lines and footprints of the video frames are seen on the map, including those from multiple airborne platforms.

FMV is used to create composite mosaics of an area of interest, which is like using the video to "paint" an area with an updated basemap. This is particularly useful for pipeline corridor mapping, where a strip map can be quickly and affordably captured. The process is repeated to create change detection maps.



↑ In this FMV video clip, features of a pipeline are digitized from the window and put directly into GIS.



↑ Overlay of UAV orthoimage and 3D point cloud data from a road construction site in ArcGIS Online. UAV data is processed and delivered via online services for rapid turnaround and user convenience.

Perhaps the most powerful FMV GIS function is to capture features directly from the georeferenced FMV player window. For example, a GIS analyst plays back a video that was recorded along a pipeline and pauses the action at any time to capture features of interest, such as encroachments. Using heads-up digitizing, the user captures features with a mouse and stores them directly in ArcGIS. This capability improves the timeliness and capture of features for high-consequence areas (HCA) and other types of reports.

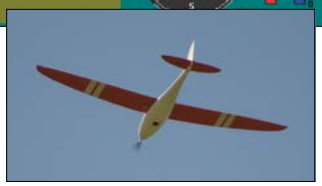
Emergency response managers can also use FMV. Because an FMV camera does not need to be perfectly perpendicular to the ground, an aircraft can be flown at a safe distance from an oil spill and capture FMV at an oblique angle. The operator can then feed the scene in real time to GIS viewers inside the incident command post (ICP) miles away. This greatly enhances the common operational picture (COP). Having a source of real-time visual intelligence for the COP is a game changer over traditional methods. The turnaround time for maps of the spill plume during the 2010 Gulf of Mexico spill was a half day at best. Obviously, by that time, the oil had moved. If responders had been able to use FMV, the disaster information could have been processed and viewed in near real time.

The military has used FMV for many years. Now, the private sector is beginning to realize the advantages that this technology offers. Just as GPS moved from its original role as a military navigation tool to a civilian mapping tool, FMV has the potential to become a standard data source for GIS.

The video must be geoenabled to be used in GIS. Standard video does not include sufficient locational information on the aircraft and sensor combination to be of any use. At best, with nongeoenabled video, all the user can do is track a moving dot showing the location where the video was captured. FMV actually places the video on the map, where it can be processed into value-added information.

Traditional Imagery from a Nontraditional Source

Unmanned aerial vehicles safely fly at very low altitudes and much lower speeds than manned aircraft, resulting in incredibly detailed imagery down to two-centimeter ground pixel resolution. Small UAVs can also capture 3D point clouds at the same time as the imagery. These point clouds are very similar to lidar and can be used to create stunning 3D scenes and perform volumetric calculations in GIS. Because



↑ This is the GIS-based ground control and flight operations interface. As the UAV flies its mission, the flight lines are tracked and adjusted as needed. Right: The RQ-84Z AeroHawk UAV, shown in flight, is used by Flightline Geographics to capture FMV data at a low cost.

UAVs have unique flight characteristics, they can also capture data in difficult spaces, such as areas underneath overpasses and bridges; within agricultural fields and fragile wetlands; or other areas, which may not be accessible to ground vehicles.

Many parts of the world have no restrictions on the use of UAVs for mapping and data capture. But in the United States, the current rules only allow for certain government organizations and universities to obtain permission to fly. That permission comes in the form of a Certificate of Authorization (COA), which is issued for specific project areas and particular models of UAVs. So it is cumbersome, if not impossible, to do commercial mapping with UAVs in the United States at this time. Waypoint Mapping is currently working on several projects within three separate COAs in the country.

A recent status report from the Federal Aviation Administration (FAA) explained that it will take a few more years to come up with acceptable safety rules and procedures before it will authorize widespread use of UAVs in national airspace. So for now, other countries are leading the way.

Few organizations outside law enforcement maintain their own airborne fleets, so many GIS users will be ordering and receiving data deliveries from service providers, just as they do now with traditional imagery. Waypoint Mapping has launched a new aerial services division called Flightline Geographics that captures, processes, and delivers FMV data and UAV technologies for a variety of GIS organizations.

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Download the Full Motion Video 1.1 template with the FMV documentation, tutorial exercises, and data from arcgis.com.

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