



Incident Commander Info Sheet Civil Air Patrol ARCHER System



ARCHER: Airborne Real-time Cueing Hyperspectral Enhanced Reconnaisance

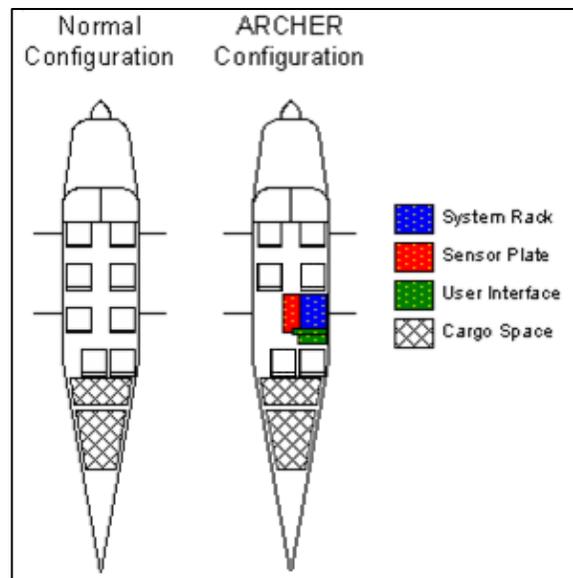
Overview

- ARCHER is a custom-designed system of hyperspectral imaging (HSI) hardware and software with real-world applications for search and rescue (SAR), disaster impact assessment and relief, homeland security, and potentially counterdrug operations.
- ARCHER HSI executes three separate algorithms for target acquisition and detection:
 - Spectral signature matching: ARCHER can be programmed to look for specific colored objects;
 - Anomaly detection: ARCHER compares objects on the ground and identifies colors that don't "fit" in with the normal background environment. This is the most likely way the CAP is going to find a SAR target with ARCHER;
 - Change detection: ARCHER executes a pixel-by-pixel comparison of current ground conditions against ground conditions that were obtained in a previous mission over the same area. Scene changes are detected as new targets, departed targets, or moved targets. Targets are highlighted for evaluation. Change detection can only be done post flight on the ARCHER ground station.
- Data on possible "hits" that match the spectral signature, anomalies, or changes can be processed in real-time, stored and analyzed, and transmitted to CAP ground teams or customers as necessary.

Deployment Requirements

- ARCHER is flown aboard the 16 Gippsland GA-8 Aircraft strategically placed throughout the country.
- An ARCHER crew is made up of a mission pilot, another mission pilot or experienced observer, a qualified ARCHER Operator, and an ARCHER Trac Technician or another ARCHER Operator.
 - The second mission pilot or senior mission observer does not need to be GA-8 qualified, but ideally should be familiar with the GA-8 aircraft communications systems.
 - The second mission pilot or senior mission observer can be from the local wing that the primary crew is deploying to support.
 - The primary mission pilot would normally deploy with the aircraft, but for long duration missions (those lasting longer than a few days) current and qualified local GA-8 pilots will likely be required to meet mission needs.

- ARCHER crews **must** take the system's ground station when they deploy to a mission base.



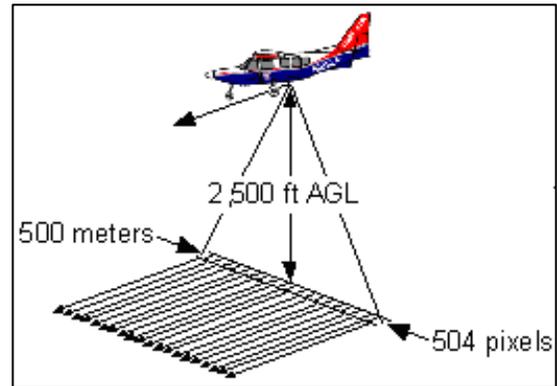
ARCHER GA-8 Seating Configuration

- The ground station allows ARCHER operators to analyze data already collected while an airborne crew collects more data. Stored data can be used to "re-fly" a mission to search for different spectral signatures, anomalies, or changes without having to launch an aircraft.
- The ground station can be used anywhere a typical PC can be used, although it requires more desktop space. All that is required is 110 VAC power for the system processing unit and the two monitors. The drive bay is powered from the system processing unit.
- The ground station software is identical to the airborne system software. The ground station is used to replay recorded mission data. Playback speed can be varied by the system operator. The fastest playback speed is about three times faster than real time, so a 90-minute search mission can be fully replayed in about thirty minutes. The playback speed can also be slowed to approximately one-half real time in order to more thoroughly review segments of a sortie.

- Ground station operators can also provide high resolution images of locations captured in flight using the “chip-on-demand” feature if one was not created in flight, and even tile these chips together in a mosaic format to piece together imagery for large areas if necessary.
- Additional ground stations can be shipped to a mission site to allow additional analysts to work if necessary. A replacement ARCHER system can also be shipped to a mission site from the CAP National Technology Center (NTC) should a sensor or other part fail. Should you have a maintenance problem during a mission, contact the National Operations Center duty officer at 888-211-1812 ext. 300 and the duty officer will coordinate with the NTC for emergency technical support. During normal duty hours the NTC can be reached at 866-600-2071 for technical support.

Operating Limitations

- ARCHER is designed for missions to optimally be flown at 2,500 ft AGL at a ground speed of 100 knots. At these conditions, the HSI sensor will “see” objects that are at least one square meter in size within the ground swath of 500 meters. ARCHER was designed to be able to fly missions as high as 5,000 ft AGL, but the higher the system is flown the less effective it will be. Flying ARCHER lower than 2,500 ft AGL can possibly allow ARCHER to pick up smaller sized objects.



Effect of Altitude AGL on Ground Swath Width and HSI Camera Pixel Resolution

- HSI is a daytime non-invasive technology, which works by analyzing an object’s reflected light. It cannot detect objects at night, underwater, under dense cover, underground, under snow or inside buildings. ARCHER cannot see through clouds, fog, or heavy mist. If you cannot see the ground from the aircraft, then ARCHER cannot see the ground. Depending on how overcast the weather is, ARCHER may or may not be able to discriminate targets in rainy weather. The same illumination requirements apply in any weather condition—there must be sufficient light reflected from the ground. Wet surfaces often change the composition of light that is reflected by an object, so signature match target detection may be negatively compromised by rainy conditions.
- The best time of day for an ARCHER mission is midday with the sun high in the sky. This condition provides maximum solar illumination and maximum reflected light. Missions can be flown at other times of the day, but in low light conditions ARCHER will be less able to distinguish between similarly colored objects. This may reduce ARCHER’s ability to detect targets. At dusk, there is not enough reflected light for ARCHER to operate.
- Mission planning must take into account the start time of the mission and its planned duration. For example, it wouldn’t be an effective use of ARCHER to start a January mission at 4 p.m. that requires 90 minutes to reach the search area. By the time the aircraft reaches the search area, there will not be sufficient ground illumination for ARCHER to function in most parts of the country.
- The rule of thumb for illumination is if you can clearly see objects on the ground, then there is enough light for ARCHER
- ARCHER is not designed to be flown for searches in large areas. With a swath width of half a kilometer at optimal operating altitude and crews overlapping swaths by 25% to insure proper coverage, it would simply take too long to search large areas. It would not be used to fly the entire area of possibility for missing aircraft search for example, but rather should be used to fly high probability areas like around identified radar drop-off points or waypoints identified on a flight plan. ARCHER is usually not effective in missing person searches and won’t be effective if you expect the target to be located in a heavily forested area under dense cover. The sensor must “see” at least one square meter of the object being searched for in order to locate it.

For more information on the Civil Air Patrol ARCHER System:

Contact the CAP National Operations Center at 888-211-1812, extension 300 in an emergency, or email opscenter@capnhq.gov for routine requests for support or information.