CASE STUDY

Organization Successfully Verifies Object Trajectory Using High Speed Cameras

CURTISS-WRIGHT

Challenge

- Required accurate data to confirm position and velocity to validate models
- A harsh environment was hostile to most cameras
- Missions cost was very high; limiting number of missions was a priority

Solution

- Multiple cameras installed on the aircraft
- Ruggedized camera withstood harsh flight test conditions
- A telemetry system was established to review sample images rapidly during flight

Results

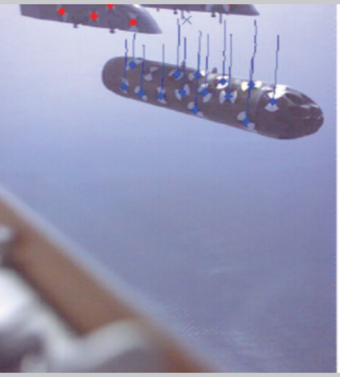
- A high speed camera network successfully gathered the required data
- Installed cameras were able to withstand the harsh conditions
- Captured mission data confirmed ASAP to prevent landing without required data

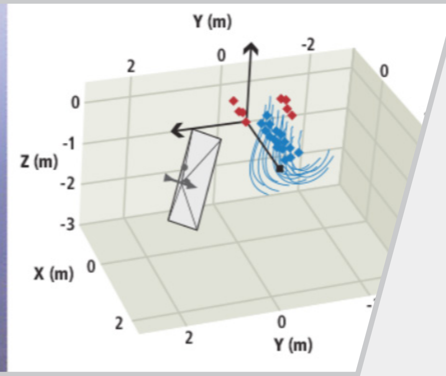
Challenge

An organization needed accurate data to confirm position and velocity of objects during store separation testing. Validation of prediction techniques (such as wind tunnel and mathematical modeling) was required to complete Flight Test Instrumentation (FTI) studies. The speed at which the events would happen made it necessary to use a high speed imagery solution.

The cameras were located outside a military aircraft and subjected to harsh environmental conditions including shock, vibration and temperature. While many cameras on the market may be suitable for different climates and for extreme sports or industrial applications, few are able to work optimally while experiencing these conditions.

The cost of flying the test missions was very high, as with all test flights. In addition to the high cost of flying the aircraft, the ground support team, infrastructure, and additional resources for setup and post mission analysis further increased the cost. A test flight that resulted in bad data and required another flight was therefore to be avoided if possible.





Network-based High-Speed Camera nHSC-36-S1(M)-1

Solution

A large network of cameras was implemented that could record the fast-moving objects as digital images onto a recorder (in this case an Advanced Data Server and Recorder (ADSR)). After recording, these images could be played back in slow motion for scientific study of transient phenomena. The cameras were networked and controlled via the nMGR-2000 network camera manager and were capable of capturing data at frame rates in excess of 500 frames per second. The core switch served as a network fabric to pass message packets from the cameras to the recorder in a way that ensured data coherency.

Curtiss-Wright supplied rugged high speed cameras (nHSC-31-S1(M) and nHSC-36-S1(M)) designed to capture high-speed imagery and record data in the harsh environmental conditions of aerospace test applications. These include random vibration of 15 Grms from 20 to 2,000 Hz for 10 minutes on any axis, acceleration of 25 g indefinitely on any axis and operating temperatures of -40°C to +60°C.

A system capable of telemetering RS-170 data was developed that could be setup with pre-arranged parameters to send particular images from designated cameras to check an event was captured successfully. For example, every 10th frame from two different cameras for 5 seconds might be transmitted. This was controlled via the nMGR-2000 network camera manager. In addition, an algorithm was installed on the video recorder that would flag if there was a problem recoding data to protect against any setup or wiring issues.

Results

A high speed camera network was successfully installed that coherently gathered the required data. This data was recorded to the ADSR via its two 2 Gb ports that wrote data to multiple solid-state media. This parallel operation ensured data could be stored at a sufficiently high rates and allowed for fast downloading post mission (on the order of 5 minutes).

The network of cameras experienced no performance degradation because of adverse conditions and fed good quality data to the network as expected. A telemetry system was established to review sample images rapidly during flight that ensured checks could be performed to validate the capture of useful datasets. Along with the recorder check algorithm, this ensured that no faults led to another mission being flown unnecessarily. This data was then used to successfully verify the trajectory of the objects in question and allow the project to proceed towards completion.

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