

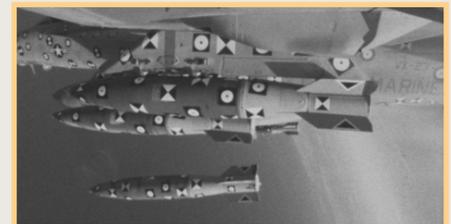
# Photogrammetrics



Photogrammetrics is a technique used to extract reliable measurements from video and/or film. ATR's Photogrammetrics technicians, mathematicians and software developers reduce image data received from digital and high-speed video cameras, and also from cinetheodolites and other instrumentation sources. Targets placed on aircraft and stores are tracked frame-by-frame for precision analysis of image data. Projection geometry, nonlinear optimization, and other mathematical techniques are used to reconstruct the optimal 3-degrees-of-freedom (3-DOF: x, y, z) or 6-degrees-of-freedom (6-DOF: x, y, z, yaw, pitch, roll) trajectory that best matches the 2-D tracking data. In addition to the application areas described below, Photogrammetrics also provides analysis for overhead impact scoring, mishap reconstruction and other unique tests.

## STORE SEPARATION

Photogrammetric techniques help determine the envelope for safe weapons release from an aircraft. A photogrammetric solution consists of a 6-DOF time history, from which velocities and rates can be computed. An important quantity that is derived from the 6-DOF time history is the miss distance, which is a time history of the closest point of approach between the surface of the moving store and the surface of another object, such as the aircraft's fuselage or a fuel tank.



Store separation

## SHIP SUITABILITY

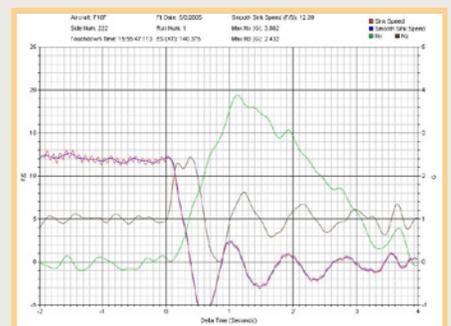
Using the Minilir portable laser/IR tracking mount, the team produces a near-real-time 3-DOF time history for the aircraft as it touches down and catches the wire. ATR also uses fixed cameras to determine the aircraft's 6-DOF time history. From this information other parameters are calculated, including horizontal speed, sink speed, heading, pitch and roll rates, glide slope angle and *g-force*.



Ship suitability

## FOR MORE INFORMATION

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Display Engineering Unit data

# Photogrammetry

## OPTICAL TSPI



Optical TSPI

Using four cinetheodolites strategically located at sites along the Chesapeake Bay, the 3-DOF trajectory of an aircraft and/or a store released from the aircraft is estimated using triangulation. The trajectory is then used to calculate

velocities and accelerations. This data is used in applications such as ballistic trajectory calculations, weapons delivery accuracy and airspeed calibrations.

## HORIZON

The current film and video analysis system, Horizon, is designed to automate the photogrammetric flight test data reduction and analysis process.

### TRACKEYE SYSTEM INTEGRATION

- ATR-developed analysis procedures integrated into Image System's TrackEye software

### ACCURACY

#### For store separation data:

- 1 inch in X, Y and Z
- 1 degree in yaw and pitch
- 3 degrees in roll

#### For ship suitability data:

- 1 foot in X, Y and Z
- 1 degree in yaw, pitch and roll

### BENEFITS

- Data quality assurance and integrity
- Automatic setup procedures to decrease procedural complexity
- Decreased image processing time
- Instant feedback on data quality
- Derived data and miss distance data produced immediately after 6-DOF
- Turnaround time less than three hours after a store separation flight

## FUTURE: HIGH-SPEED PHOTOGRAMMETRY

### GOALS

- Turnaround time for multiple events less than three hours after a store separation flight, and a matter of minutes for ship suitability tests
- Maintain or exceed current data accuracies

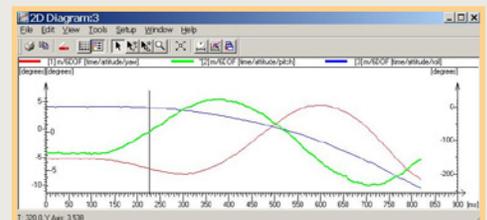
### PLANS

Research and develop new techniques to improve:

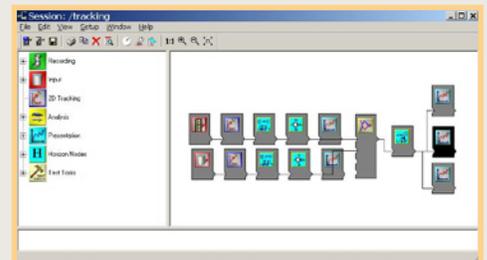
- Acquisition and identification of targets in image sequences
- Auto-tracking of targets with increased reliability and accuracy
- Computation of 6-DOF and derivatives from target data

### BENEFITS

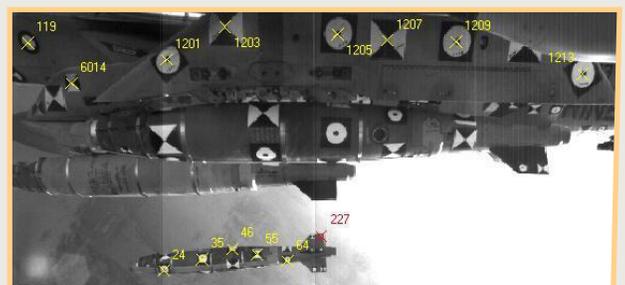
- Improved data accuracies during dynamic multiple object releases
- Near-real-time results



Tracking data



Horizon TrackEye software



Tracking aircraft targets