image SYSTEMS
MOTION ANALYSIS

STORE RELEASE ANALYSIS
TRACKEYE 6-DOF

Store Release Analysis

Analyzing the 6D behavior (3D position and attitude angles) of a rigid structure (rocket or store) being fired or dropped from an aircraft flying is not an easy task.

There are few places where the camera can be mounted to ensure good acquisition and the geometry of the projectile (a relatively long and thin object) can become an issue for accurate 3D positioning.

Airborne cameras are generally mounted on pylons or directly on the fuselage of the aircraft with wide angle lenses which requires powerful lens calibration and dynamic camera orientation to compensate for vibrations.

TrackEye store release package is then the perfect toolbox for store analysis. The distortion of the lens is quantified and corrected in the software through automated routines using a smart calibration board and the dynamic orientation of the camera is calculated during the flight using reference points on the aircraft.

The TrackEye software can combine CAD data from 3D scanners with a minimum of one camera view to allow 6D analysis of rigid bodies with subpixel accuracy and less than 1 degree for attitude angles making it the world standard for military ranges.

The 3D trajectory of any point of the 3D model of the dropped object can be visualized in 3D diagrams along with the object itself. Additionally, the shortest distance between any point of the store and the aircraft can be calculated at every frame to ensure a safe separation distance between the store and the aircraft is maintained during the test.

ROBUST SOLUTION

- Unlimited number of tracking points.
- Minimum 1 camera view needed for 6D solution. Multiple cameras can be combined to increase the accuracy on the analysis and for covering the event.
- Dynamic compensation for camera vibration and relative 6-DoF analysis.
- A minimum of 4 reference points (more recommended) spread on the rigid body need to be tracked in each frame for 6-DoF analysis even in harsh conditions.

  Those 4 points can be shared among several camera views.

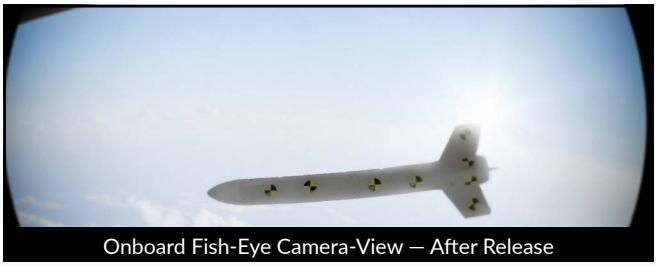
FLEXIBLE COORDINATES

The coordinate system in which the 6D will be calculated can be defined in the TrackEye software using:

1. The orientation of the dropped object in a specific moment when there is no additional reference object (no aircraft for instance).
2. The orientation of a reference object in static or dynamic (for instance the aircraft) to get the relative 6D of the dropped object.
3. The orientation of a camera in a specific moment (static orientation) or recalculated at every frame (dynamic orientation). This requires camera orientation.
4. The 3D position of points on the scene to define a new origin and axes directions.

Extended point of view of the store release from Wingman

Onboard Fish-Eye Camera-View – Before Release



Onboard Fish-Eye Camera-View – After Release

ADVANCED CALIBRATION AND SURVEY

Smart Lens Calibration Board:

Precise focal length & Lens distortion calibration for ultra-wide and fish-eye lenses

- Robust material and protection
- Multiple sizes covering A1-A7 format
- High accuracy and excellent flatness 0.1mm
- Pattern Auto Recognition

3D Scanner Toolkit:

Photogrammetry solution for rigid body objects

Technical Specifications	Space Spider	Eva	Leo
3D point accuracy, up to (mm)	0.05	0.1	0.1
3D resolution, up to (mm)	0.1	0.5	0.5
Volume capture zone (cm^3)	2,000	61,000	160,000
3D reconstruction, up to (fps)	7.5	16	22

3D RECONSTRUCTION

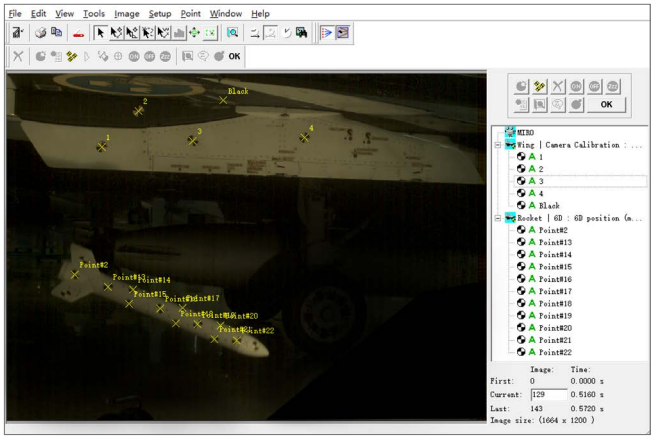
3D models (.obj with texture or .stl) of rigid body objects generated with CAD or 3D scanners can be imported and mapped to tracked points for:

- Retrieving the 3D position of any point of the 3D model even if not tracked or not visible from the camera point of view during the test.
- Calculating the shortest distance between a point and a 3D object or between two 3D objects for each frame.
- Visualizing the 3D model animated according to the tracked data and getting a full understanding of the 6D behavior during the test.

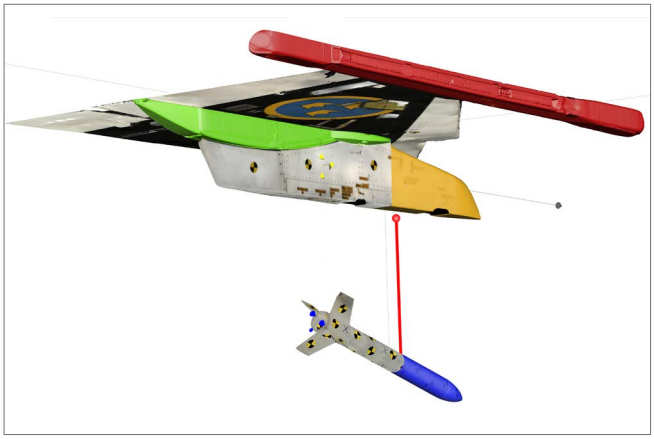
EXCELLENT ACCURACY

- Advanced tracking algorithms for following any potential marking on the object.
- Up to 0.01 pixel tracking accuracy.
- Friendly lens calibration wizard to quantify and correct distortion from ultra-wide lenses and calculate real focal length.
- Error checking tools for possible swap of points.
- Parallax, back projection tool to control the accuracy of the 6D solution with possibility to weight points according to their residuals in each frame.
- Multi-camera solution for higher 3D accuracy.

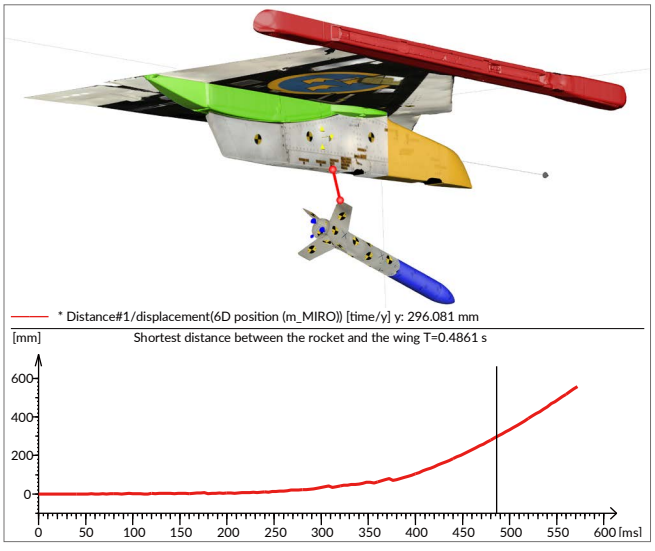
STEP 1:
Import high-speed camera views and 3D models.
Place markers on objects to be analyzed.



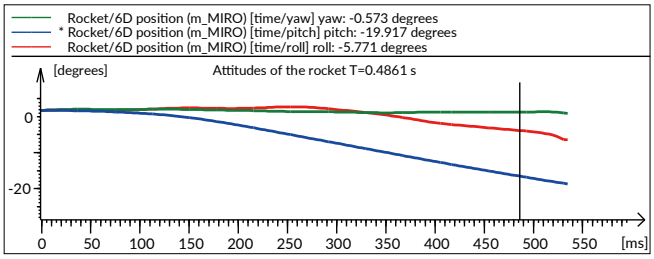
STEP 2:
3D reconstruction for tracked objects, rotate 3D diagram to investigate interesting areas and retrieve data.

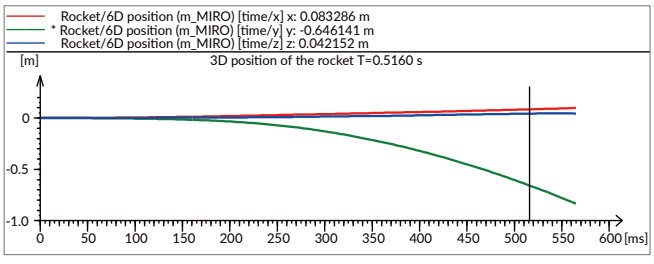


STEP 3-1:
Calculate rigid body shortest distance



STEP 3-2:
Export statistics and diagrams for attitude and displacement





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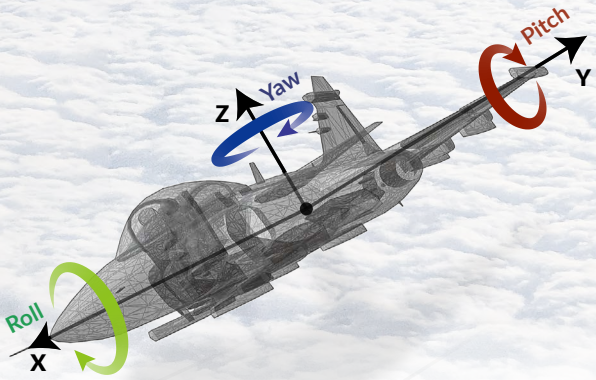

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