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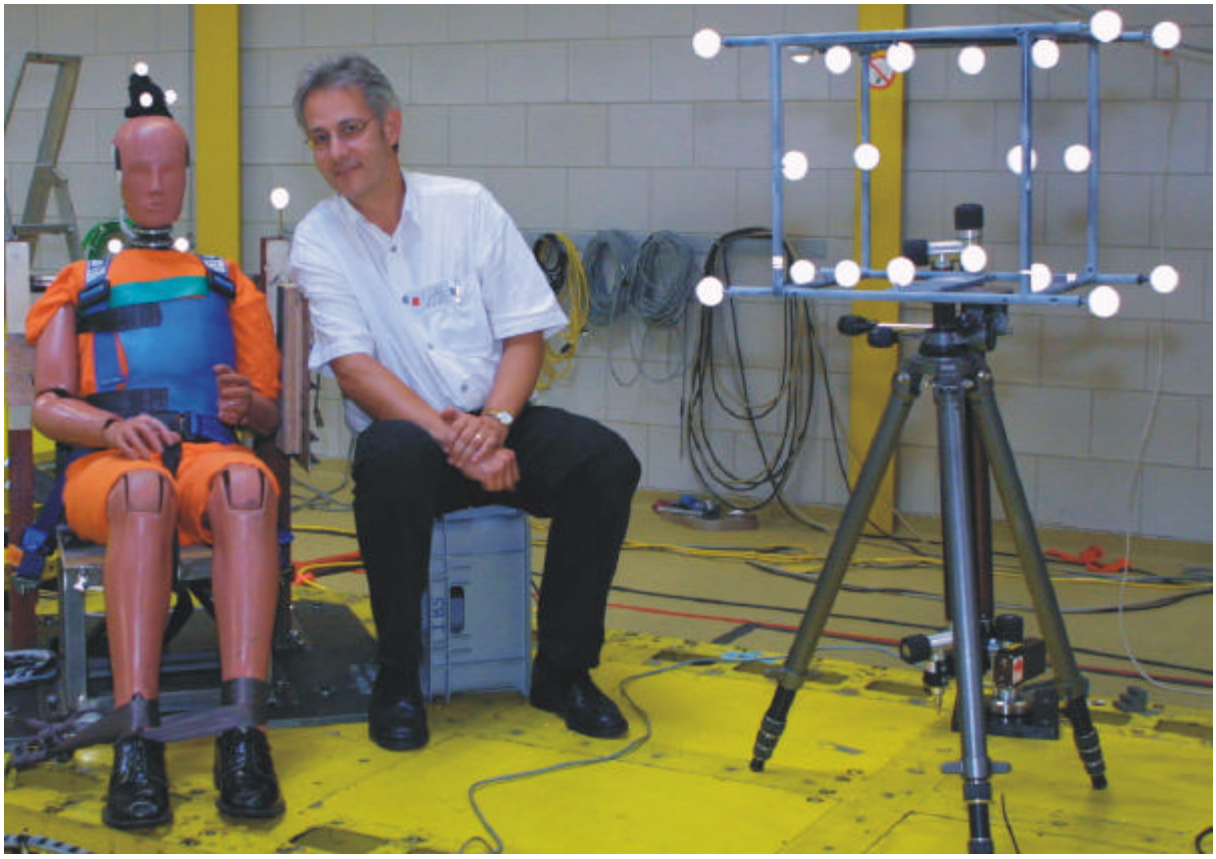
3D Evaluation of Impact Tests by TNO Automotive and FalCon eXtra

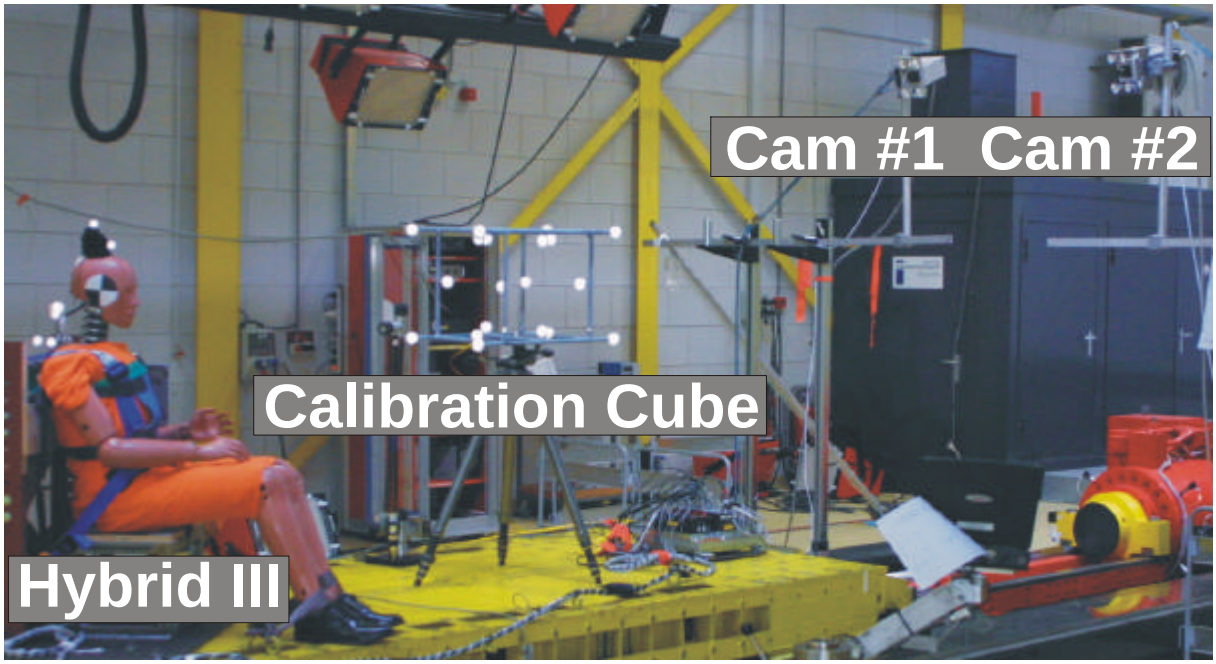


Task

Recently, the 3D kinematics of a Hybrid III dummy had to be evaluated during oblique impact tests, as part of international project. **TNO** Automotive R&D decided to use high-speed video cameras and the **FalCon eXtra Mov3D** analysis software for this task.

Set-up & Targets

3D photogrammetric reconstruction requires that each target in the object space is recorded simultaneously by at least two cameras. The measuring volume should cover a dynamic range of at least 2000 mm, thus we installed the cameras at an angle of 25 degrees to the direction of sled motion.
The commonly used self adhesive, planar targets do not allow for large out-of-plane rotations. Custom targets needed to be developed allowing automatic tracking with high accuracy. Some pilot tests were done to evaluate the use of **retro-reflective spherical targets** in combination with **small halogen lights**. The spots are assembled with the camera housing thus the lighting is well directed in the line of view of the camera.



Calibration

The static exterior orientation of each camera had to be determined. For this, images of a **calibrated cubic object** have been taken before the test. The **FalCon Mov3D** analysis program measured the centers of its bright targets with sub-pixel accuracy and combined them with the corresponding 3D coordinates (measured manually by FARO) in order to calculate the 6D positions of the cameras (= station by 3D coordinates and axis by 3 angles). Photogrammetric triangulation requires calibrated cameras and lenses. This means that distortion and imaging parameters have to be evaluated. We used a quite solid **SAE J211/2 panel** and took several images per camera in a lab set-up. The results, obtained by the **FalCon CamFolder** module, proved the high quality of the used lenses and as well doubled the measurement accuracy: SAE Distortion Index = 0.12 % (calibrated).

3D Analysis

FalCon Mov3D was able to automatically track all unknown points in the stereoscopic views. 3D point coordinates were calculated via resection in space. Within a series of 5 tests the reproducibility of the set-up and of the analysis procedure could be shown. Despite the low video resolution and the motion in the line of view, the measurements are very accurate: the distance of two targets on the dummy's head, for example, does not vary more than 0.5 mm during 250 ms!