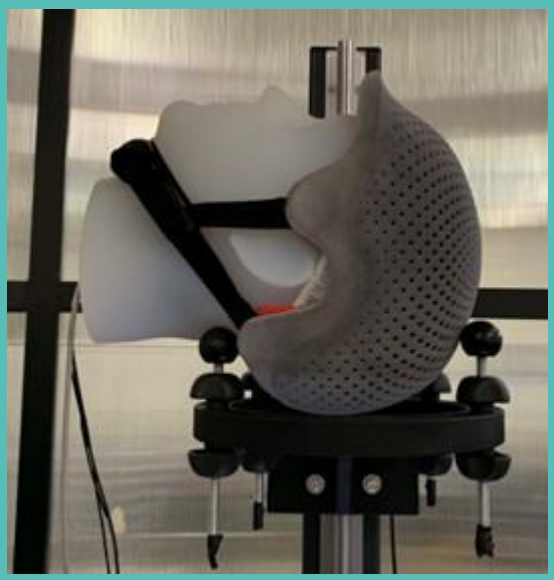
APPLICATION REPORT

THE HELMET DROP TEST - HIGH SPEED CAMERA

During the helmet drop test, it is essential to determine the impact velocity. Also, the behavior of the helmet after impact can be analyzed.
Measuring the impact velocity using the DIC method is more convenient than numerical integration acceleration from accelerometers.

The experimental setup consists of a device that simulates the fall of a human head with a helmet from a height of two meters.



▲ **Figure 1** : Helmet mounted on the test rig (detail)

▲ **Figure 2** : Drop test setup

The high-speed camera records the helmet's movement at the moment of impact. The movement of the point is analyzed, and velocity is obtained. However, the helmet is not rigid, so the strain field at the time of impact can be shown.
Thanks to the wide range of measuring tools, another quantity can be evaluated. From the analysis, it is possible to estimate the behavior of the helmet after bouncing off the ground. Also, C# scripting can be used to create customized solutions due to access to data files.

Before the test, the calibration of the system is necessary. The claibration grid is positioned in front of the camera, at the place where the impact occurs and then, the calibration is performed.

KEY WORDS

- Drop test
- Helmet
- High-speed
- Strain field

TEST SETUP

- High-speed camera
- Helmet
- Alpha DIC software tools:
  - Point Probe
  - DIC Area
  - Post process

OUTPUT

- Impact velocity
- Full field strain analysis

MEASUREMENT PROCESS AND TOOLS

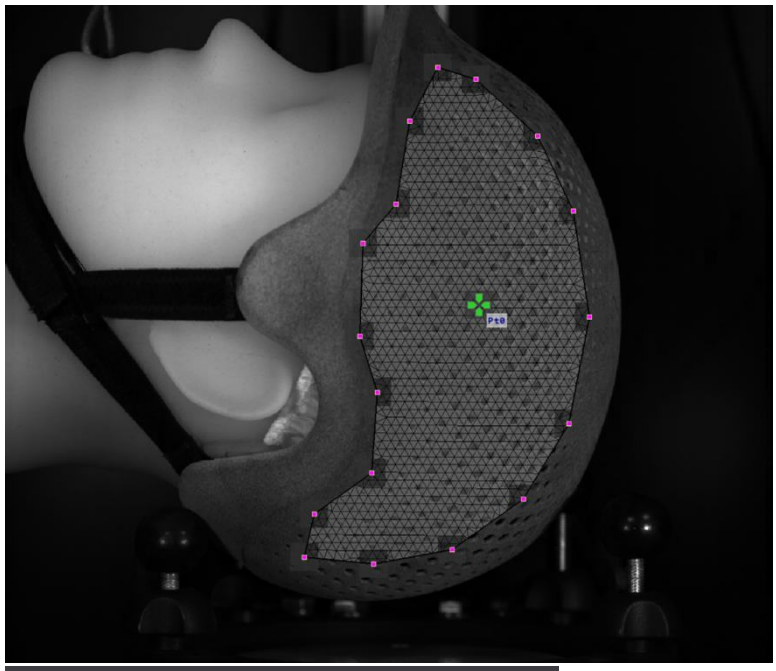
Point probe Analysis

Movement tracking in specified direction (displacement, velocity, acceleration)

- The Euclidian displacement in the selected physical unit
- The directional displacement in the selected physical unit
- The Euclidian velocity or acceleration in the selected physical unit

Full-field Analysis (DIC Area)

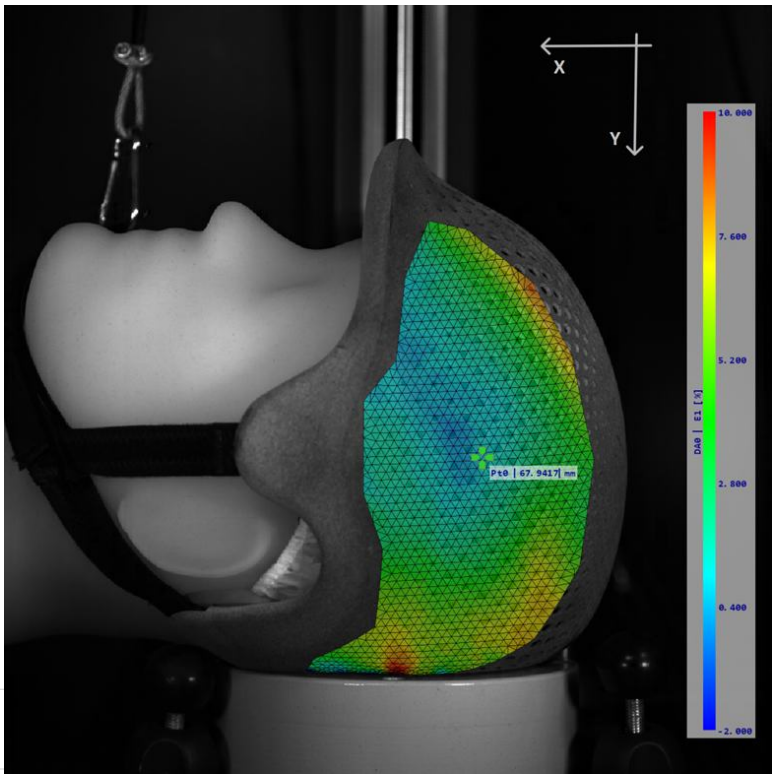
The DIC Area is a full-field probe providing a displacement or strain distribution map over user defined area. Free Edit option enables the customization of the shape and quality of the DIC area as shown in Figure 3.



▲ Figure 3: DIC measurement area definition

MEASUREMENT EVALUATION

Measured velocity and strain distribution field at the moment of impact is evaluated. To determine the velocity is sufficient 2D system configuration. For more accurate analysis of strain distribution field, the 3D system configuration is recommended. The figure captures the moment when the helmet's velocity is zero, on the graph at the time 0.314 s.



▲ Figure 4: Strain distribution field obtained using DIC

▼ Graph: Helmet velocity in the Y direction