

## Application Example: 3D Motion Analysis

### Development: 3D Windscreen Wiper Deformation

Measuring Systems: PONTOS

Keywords: Windscreen wiper

The deformation behavior of a windscreen wiper must be determined at the point of turn over. Both the local displacement normal to the windscreen and the inplane deformation of the wiper are interesting in order to analyze the impulse of the wiper onto the windscreen and generate enough data to improve the wipers' performance.



## 3D Motion Analysis / Development

### 3D Windscreen Wiper Deformation

Modern cars are designed with large windscreens to cope with the requirements of the aerodynamics. This also affects the design and performance of windscreen wipers, specifically at higher speeds. Uncontrolled behavior of wipers, due to elastic deformation and unsteady friction cause rattle and unsatisfactory wiping performance. Uncontrolled behavior of wipers at the point of turn over causes an impulse on the windscreen and therefore undesirable noise inside the car. So far, accelerometers and interferometers are used to determine the wiper deformation. However the tests are time consuming and the results are not very conclusive. While an accelerometer setup affects the dynamic behavior, the interferometer setup measures only one point at a time and requires an adaptation for each specific test. Fast and easy to apply optical 3D measurement techniques are used to solve this issue.

#### Task:

The deformation behavior of a windscreen wiper must be determined at the point of turn over. Both the local displacement normal to the windscreen and the inplane deformation of the wiper are interesting in order to analyze the impulse of the wiper onto the windscreen and generate enough data to improve the wipers performance. This measurement must take place during a fast wiper motion despite the large global movement. Furthermore, more than one point on the wiper is of interest, several points along the wipers blade and the wipers arm must be analyzed at the same time, without influencing the overall behavior of the wiper.

#### Setup:

The optical 3D measurement system PONTOS is used to measure the 3D behavior of the wiper during the time of turn over. Ten optical markers are positioned on the wiper at points of interest (Fig. 1). These adhesive markers are light-weight ( $< 0.05g$ ) and do not influence or disturb the mechanism of the process. The PONTOS sensor is positioned beside the car to observe the optical markers (Fig. 2).



Fig 1: Marker positions



Fig 2: PONTOS position

The calibrated optical stereo camera setup then is able to determine the position of each marker, for all markers at the same time. The high-speed data acquisition with 300 Hz allows capturing the fast movement of the wiper and generates enough data points for further detailed analysis.

## Results:

The 3D displacement of the wiper is displayed below. First the overall displacement of the wiper is shown on the video. The vectors on the movie (Fig. 3) describe the quantitative 3D displacement of the markers attached to the wiper.

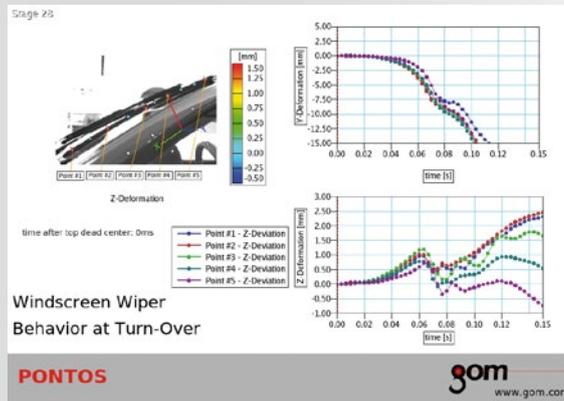


Fig 3: Quantitative 3D displacement

The displacement normal to the windscreen at the point of turn over and the displacement of the wiper in inplane direction is described in figure 4. Figure 5 shows the velocity of the wiper which indicates clear an unsteady motion of the complete wiper system.

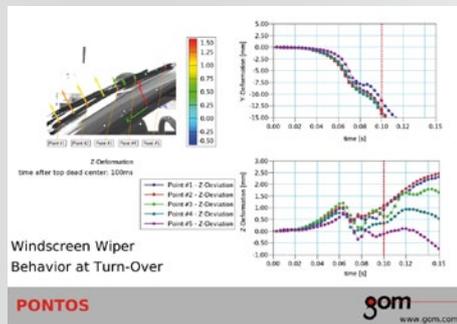


Fig 4: Graph showing displacement in Y and Z direction

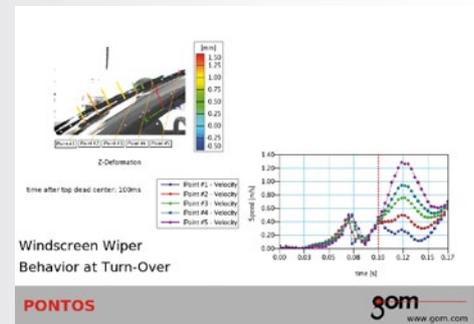


Fig 5: Velocity of the specified points at any given time

## Conclusion:

The results have shown the detailed analysis of a wiper at the point of turn over. The advantages of optical 3D measurement are seen. Many points can be measured at the same time. The sensor does not need to be connected to the measuring object and no additional coordinate measurement is required. The small and lightweight adhesive optical markers are easy and fast to apply and do not influence the mechanical behavior of the parts to be tested. The setup of the system inclusive the measurement was done in less than one hour, which is a considerable time advantage in comparison to common measurement techniques.