# MODEL DEFORMATION MEASUREMENTS (MDM) IN F1

## MDM objectives at low-speeds

**MDM measurements aim at determining the shape of a model as it deforms under aerodynamic loads. The knowledge of the actual model shape is especially critical for CFD validation, but also for aileron effectiveness for example.**

## MDM application

**The MDM system is an in-house development based on the determination of markers positions through stereoscopic photogrammetry. The markers are glued on the model and observed through two high resolution CCD cameras (2048×2048 or 4872×3248 pixels).**

**MDM measurements are available on both full-span models and half-models, over the entire operating envelope of the wind tunnel.**

## Preparation

**There is no specific requirement concerning the model. The markers, provided by Onera, are glued on the model during test preparation phase. Usually, only one wing of the model is equipped with typically about 70 markers.**

**The setup of the cameras is carried out in parallel with other preparation tasks.**

**The final system adjustments and calibration requires 0.5 working day inside the test section for the first configuration and 0.25 additional working day per additional configuration.**

## Testing

**MDM measurements are performed simultaneously with forces and pressure measurements during pitch or yaw sweeps, therefore minimal extra time is required during the test execution: +0.2 hour per major configuration change.**

**When performing tuft visualization in parallel, polars need to be repeated twice because of incompatible light requirements.**

**The markers are thin enough to have no effect on aerodynamic characteristics.**

## Results

**The MDM system is fully integrated within the F1 data acquisition and processing. MDM measurements are synchronized with classical (force, pressure) measurements, and are available at a frequency of 1Hz.**

**MDM results are available immediately at the end of each run.**

## Accuracy

**Location of each marker within ± 0.5 mm. Wing twist measurement ± 0.05° to ± 0.1°, wing bending ± 0.5 mm**

## Extra cost to the customer

**Preparation for first configuration: 14.2 k€**

**Preparation per new configuration: 7.1 k€**

**Test performance: 1.27 k€ per day**