

Incorporation of measured Wing Deformations for varying Flow Conditions into the Common Research Model CAD Geometry

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Knowledge for Tomorrow

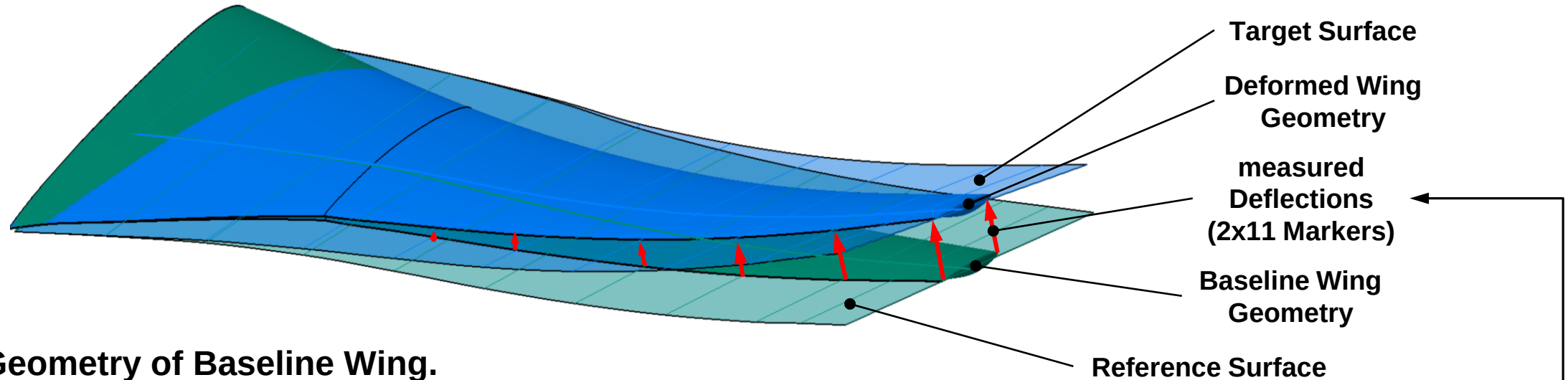


Background

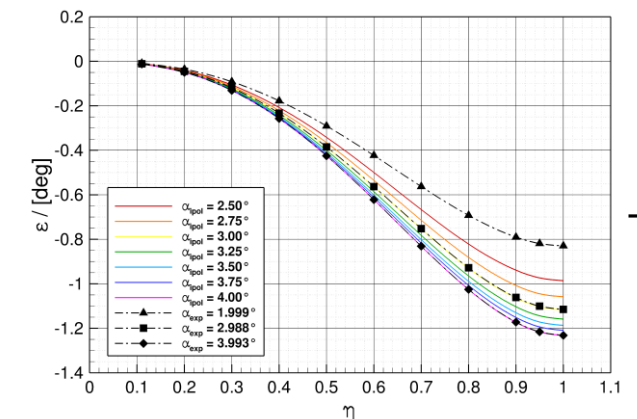
- CRM Wind Tunnel Model was built according to the Design 1g Flight Shape Geometry.
- Model Structure is subjected to a broad Variety of Test Conditions.
- varying aerodynamic Loads (q_{∞} , α) cause aerodynamically significant Wing Deformations.
- Discrepancies when comparing Wind Tunnel Test Data and CFD Results.
 - ⇒ modify CAD Geometry provided for CFD Meshing to correspond to deformed Model Wing.
- previously done for DPW-6, but additional Geometries needed and old Method no longer available.
- new Method developed, requiring only Software Tools readily available at the Institute.



CAD "Deformation" Procedure



- CAD Geometry of Baseline Wing.
- Transfer Surface linked to CAD Object (e.g. parallel to Wing Planform).
- Wind Tunnel Deformation Data (ETW TNA¹) Test Campaign, 2012).
- Deformation of Transfer Plane into Target Shape.
- Computation of corresponding Deformation of CAD Geometry.

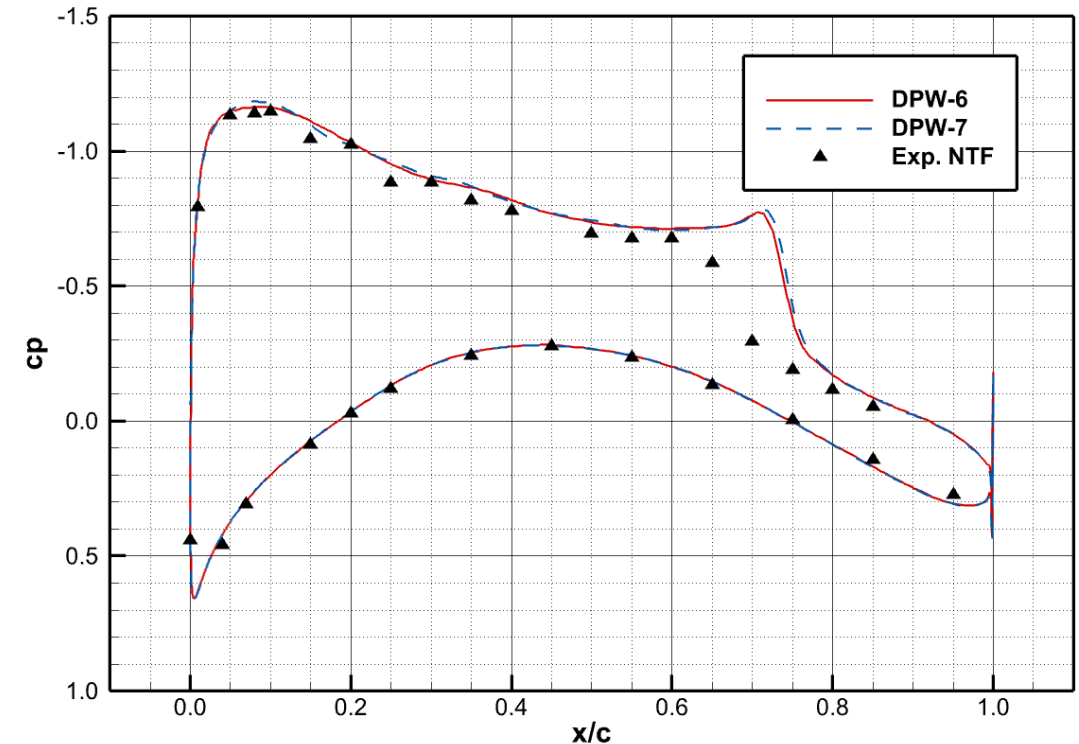


¹⁾ Trans National Access Test Campaign, European Research Project *ESWIRP* (European Strategic Wind tunnels Improved Research Potential).

CAD "Deformation" Procedure

- some minor Differences found in Comparison to existing Wing Geometries from DPW-6, e.g. Profile Thickness: $\Delta t (\eta=0.80) = 0.037\% / 11.75\mu\text{m}$.
- CFD Verification Runs performed on both Geometries.
- Results show good Agreement of both aerodynamic Coefficients (e.g. $\Delta C_L = 0.00135/0.17\%$) and static Pressure Distributions.
- Geometries accepted by Organizing Committee.

Ma = 0.85 , alpha = 4.00deg



List of available Geometries

- **dynamic Pressure:** high q (Run #182), low q (Run #237)
- **Angles of Attack:** 2.50deg to 4.25deg in 0.25deg Steps (8 Geometries)
- **File Formats & Units:**

IGES:	in, m, mm
CATIA:	mm
- **Geometries available for Download from DPW-7 Website:**

https://aiaa-dpw.larc.nasa.gov/Workshop7/Geometry/2021-03-02_Version_01/DPW7geometries.zip

P. Wegener, S. Keye: "CAD Deformation for the Consideration of Aeroelastic Effects",
33rd Congress of the International Council of the Aeronautical Sciences ICAS2022, Sept. 2022.
https://www.icas.org/ICAS_ARCHIVE/ICAS2022/data/papers/ICAS2022_0557_paper.pdf

