Integrity ★ Service ★ Excellence

RQVX CFD Efforts

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AFRL/RQVX

Capabilities

- Provide quick-turnaround simulation of aerodynamic phenomena to decrease risk and increase intuition in support of RQVX Wind Tunnel tests.
- Current Capabilities
  - 2D and 3D Freestream flow at Mach=0.05 – 3.0
    - Rakes, wings, full aircraft, etc.
  - Model in SARL at Mach=0.1 – 0.5
    - Floor mounted with mixed success
  - Model in TGF at Mach=0.2 – 0.8
  - Running “in-tunnel” CFD much more computationally intensive
- Future Capabilities
  - Model in VWT
  - TGF at supersonic Mach (need geometries of nozzle blocks)
  - Project Duration time (assuming half-time work from engineer)
    - 2D Freestream: 1 week
    - 3D Freestream: 2 weeks
    - 3D “in-tunnel”: 1 month

Ongoing and Completed Projects

12 Projects from 2014-2017

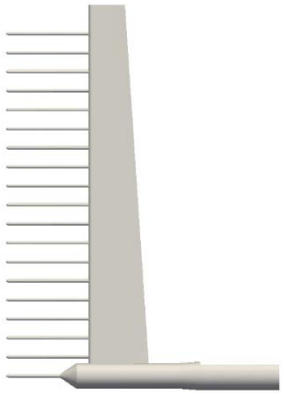
1. **[FS, VWT] Solid Wing (briefed SATA/STAI)**
2. **[FS] Ogive Shock Reflections**
3. **[TGF] Ogive Subsonic Blockage**
4. **[FS] Compliant Wing**
5. **[FS] Endplate Effectiveness**
6. **[SARL] Laminar Wing**
7. **[FS] SARL Rake 1**
8. **[FS] SARL Rake 2**
9. **[FS] VWT Rake**
10. **[FS] Five-Hole Probe (ongoing)**
11. **[FS] TGF Rake**
12. **[FS] RAWS Blockage Drag Estimate**

- **First word indicates the tunnel used (internal flow) or freestream (external flow)**

- **Abbreviations:**
  - **FS: Freestream**
  - **TGF: Trisonic Gasdynamic Facility**
  - **SARL: Subsonic Aerodynamic Research Lab**
  - **VWT: Vertical Wind Tunnel**

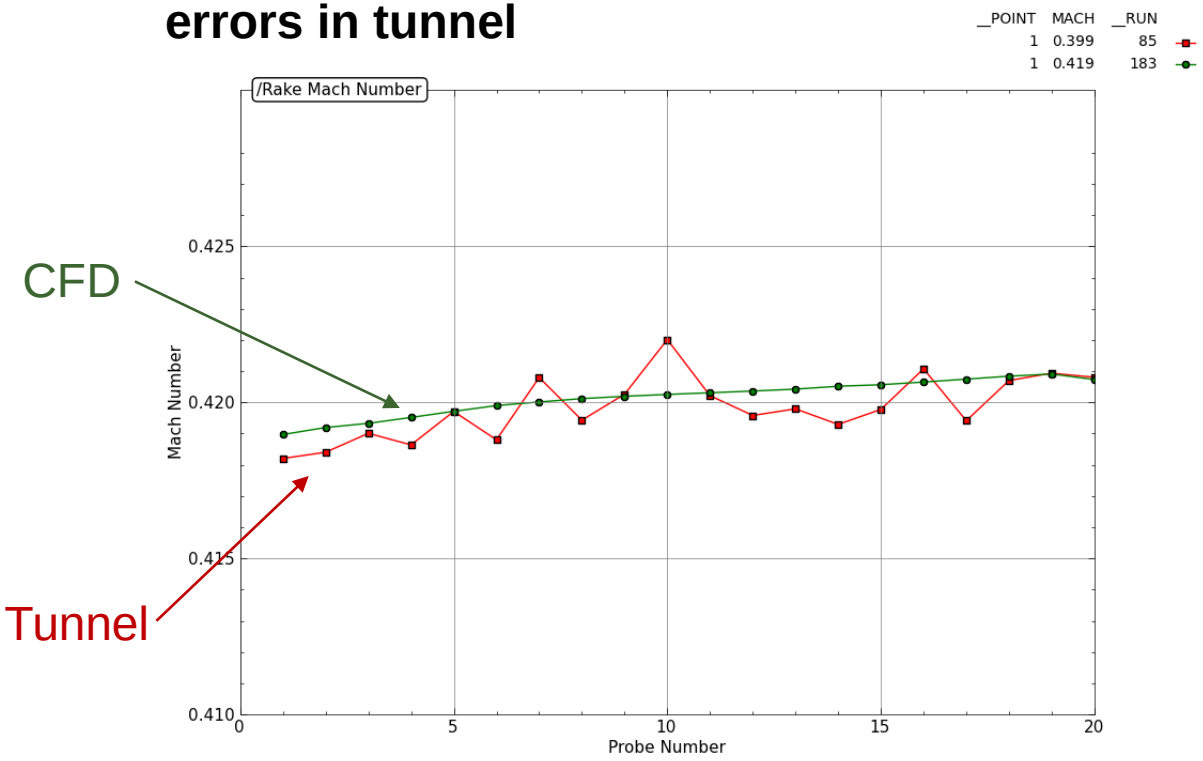
SARL Rake 1: Setup

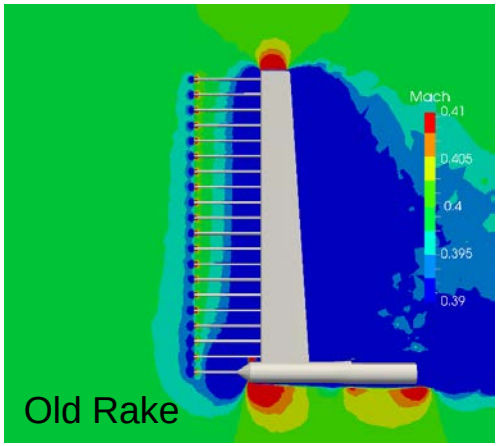
- Customer: O'Diam
- Engineer: Buscher/Keane/Chang
- Objective:
  - Assess the rake's aerodynamic influences pressure profiles across the length of the rake
  - Compare to AEDC CFD and SARL data (to validate CFD)
  - Compare old and new rake data

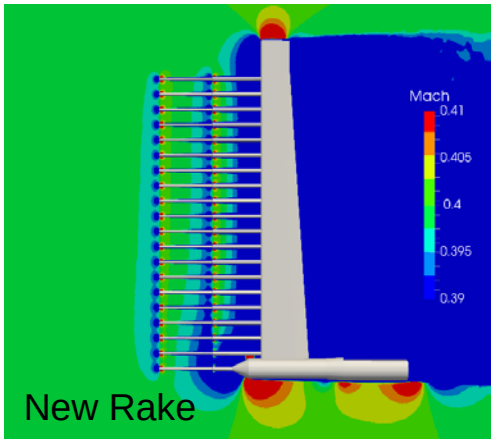


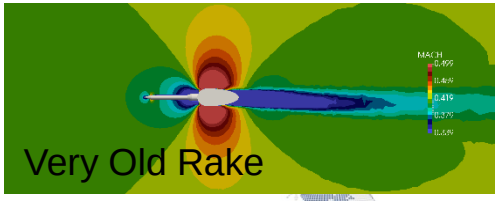
SARL Rake 1: Results

- **Determined significant aero impact from rake**
  - **Aided in design of new rake**
- **Closely matches wind tunnel data**
- **Supports suspicion of Mach number calculation errors in tunnel**





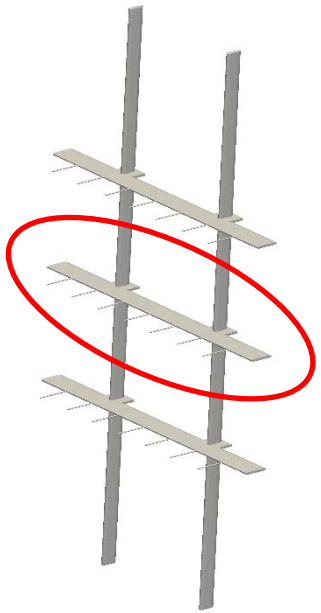




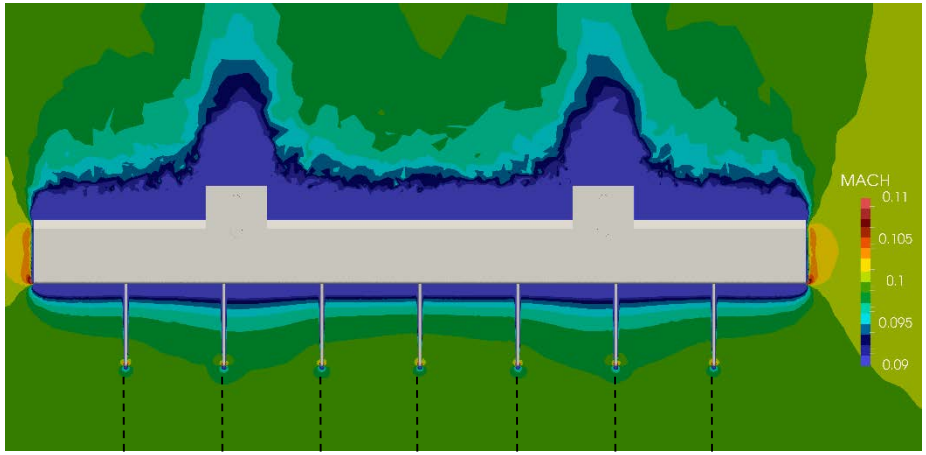
Not approved for public release

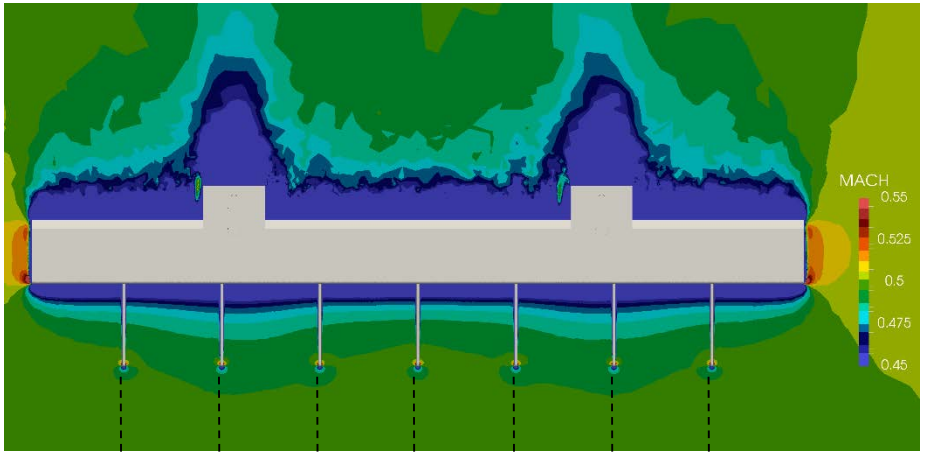
SARL Rake 2: Setup

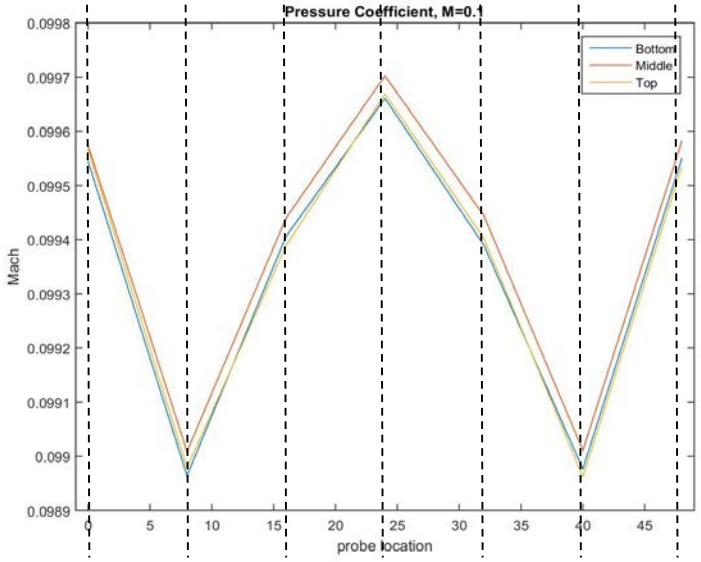
- Customer: O'Diam
- Engineer: Buscher
- Objective:
  - Determine suitability of Rake setup for determining flow uniformity in tunnel

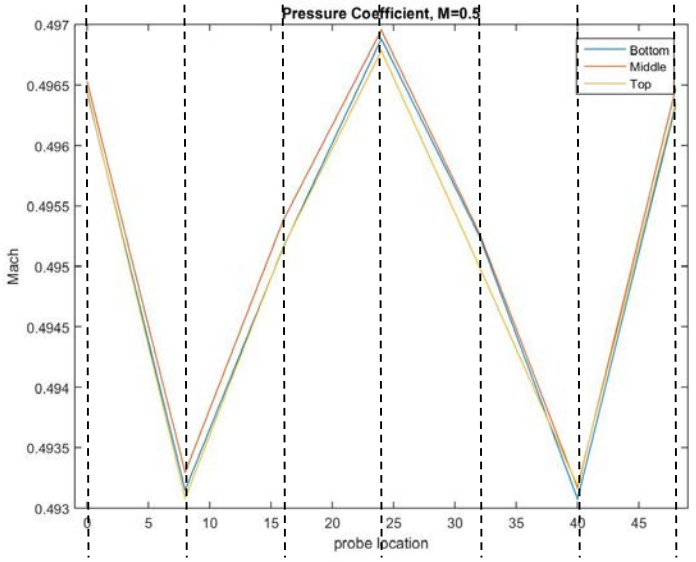


SARL Rake 2: Results



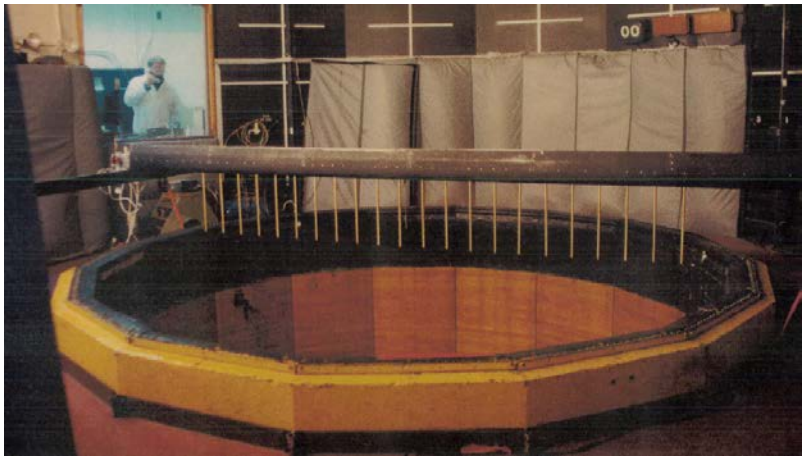


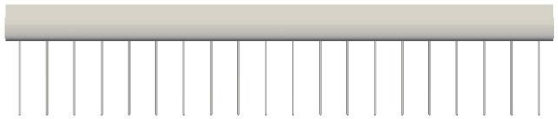


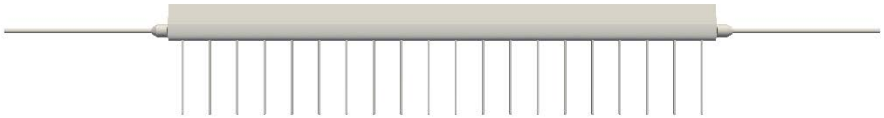


VWT Rake: Setup

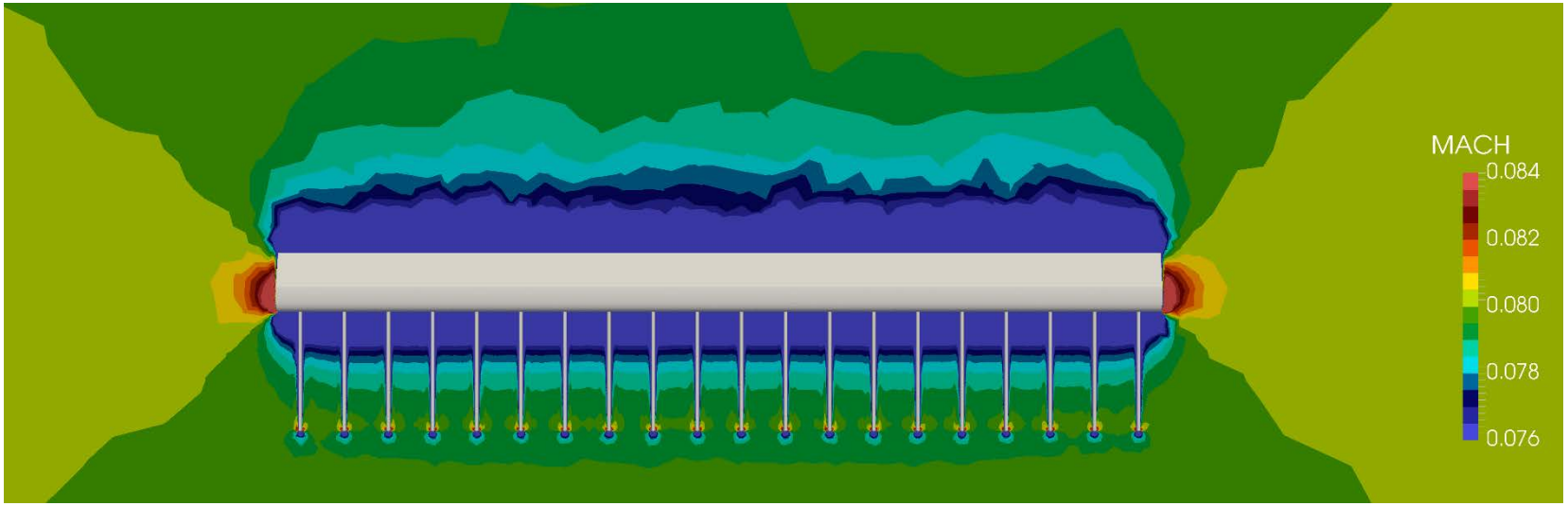
- Customer: Chang
- Engineer: Keane
- Objective:
  - Assess the rake's aerodynamic influences
  - Compare experimental data in the SARL to the CFD data we obtained

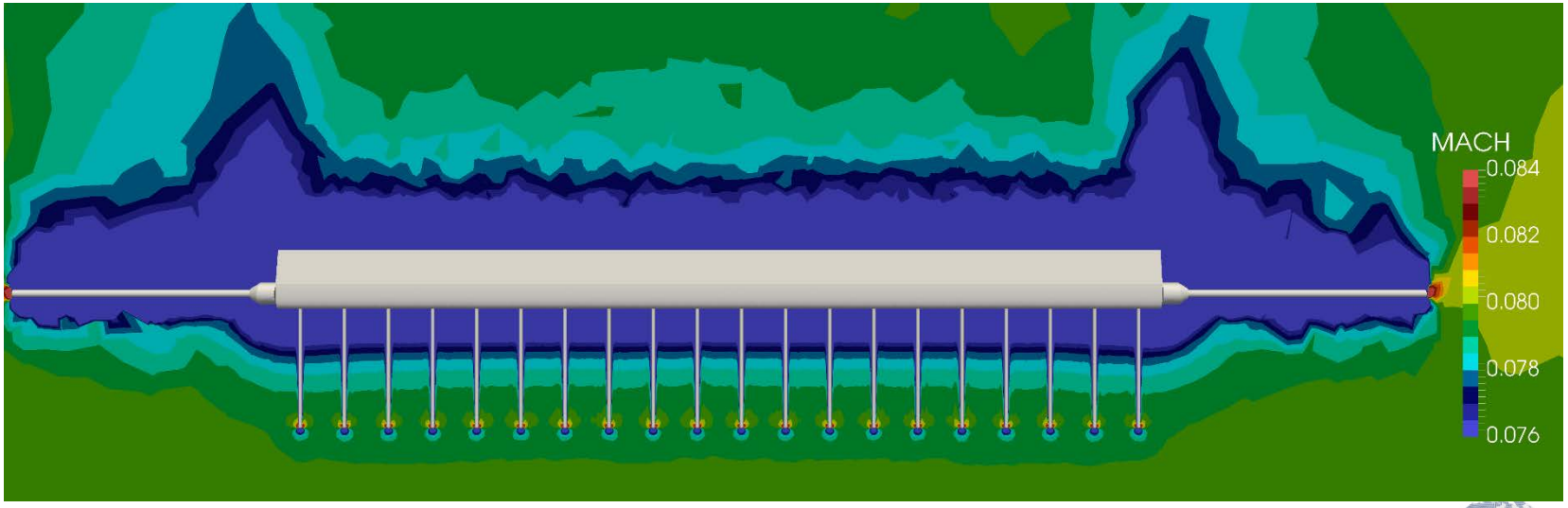






VWT Rake: Results





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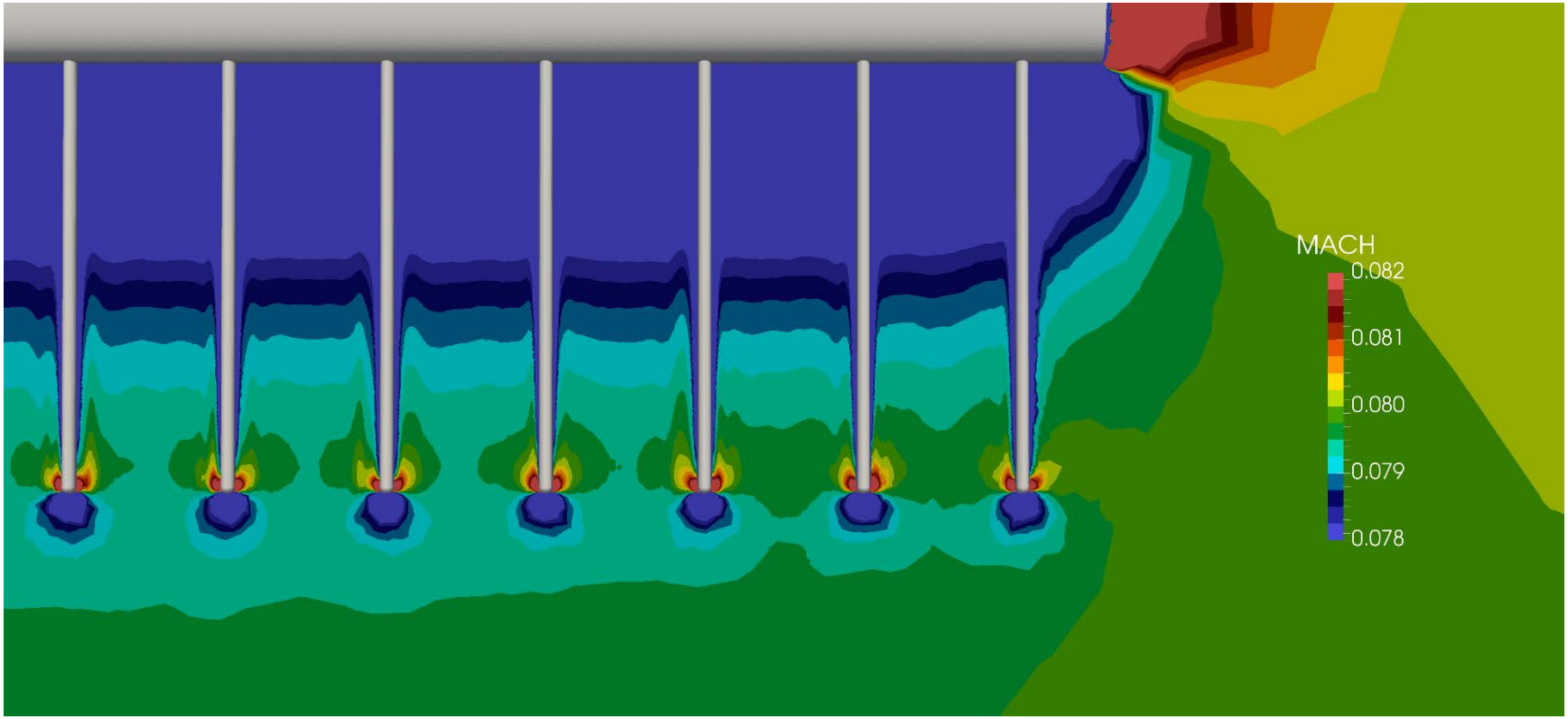

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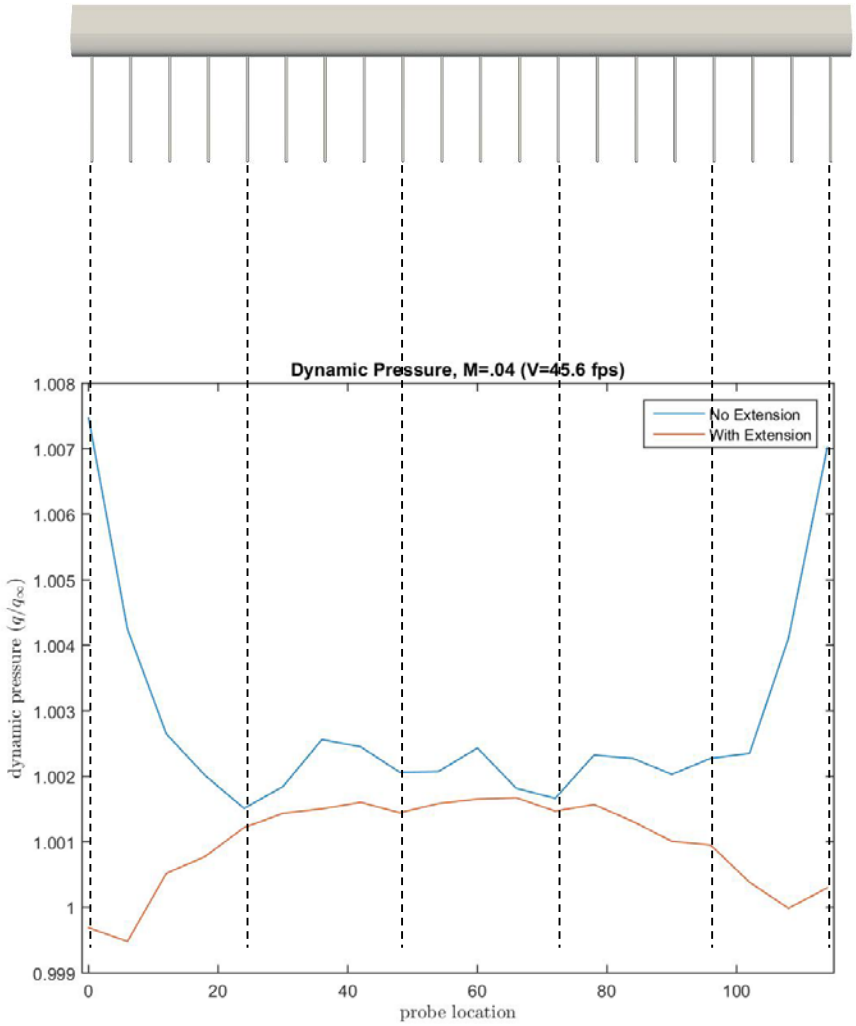
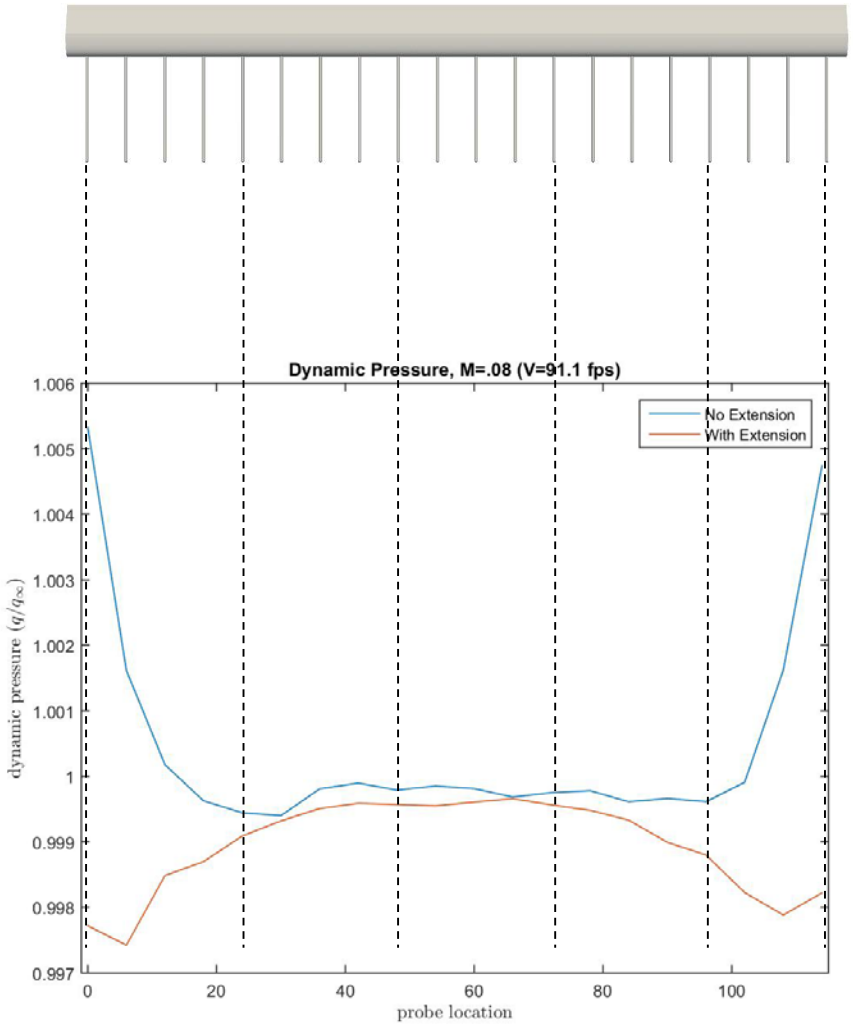
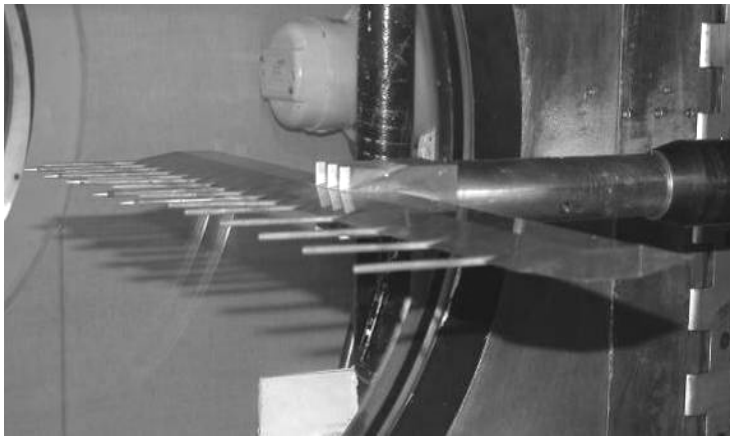
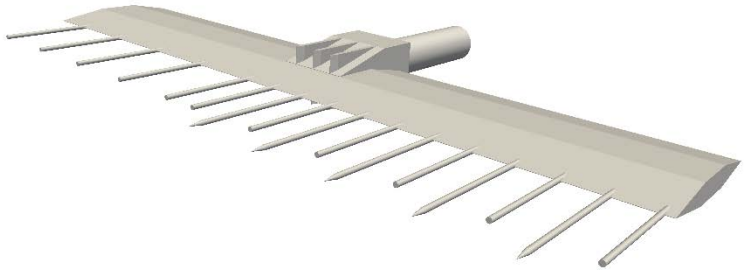




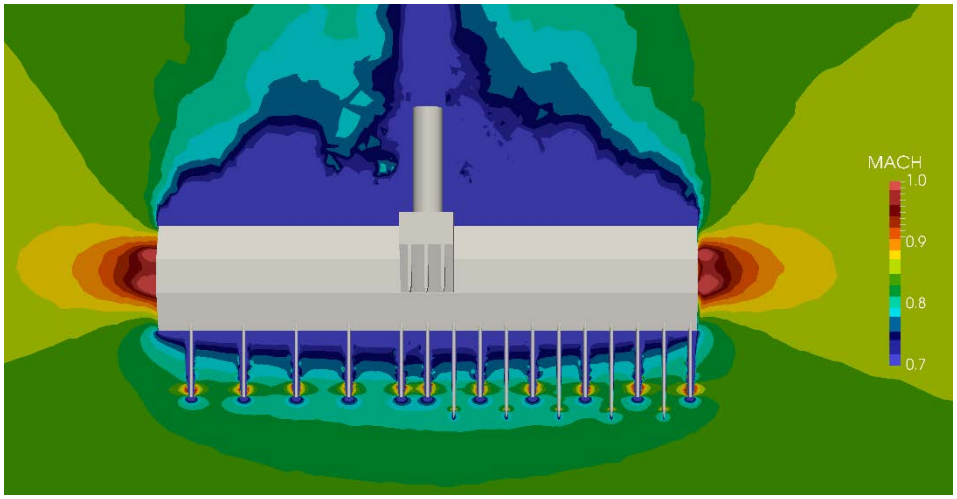
TGF Rake: Setup

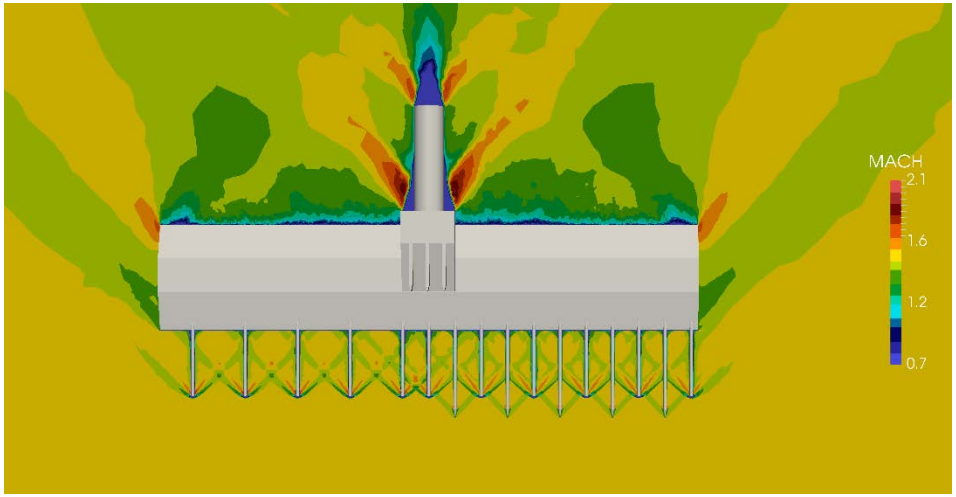
- **Customer: Semmelmayer**
- **Engineer: Buscher**
- **Objective:**
  - **Investigate “reverse boundary layer” that concerned PE during the TGF Checkout (May 2016)**

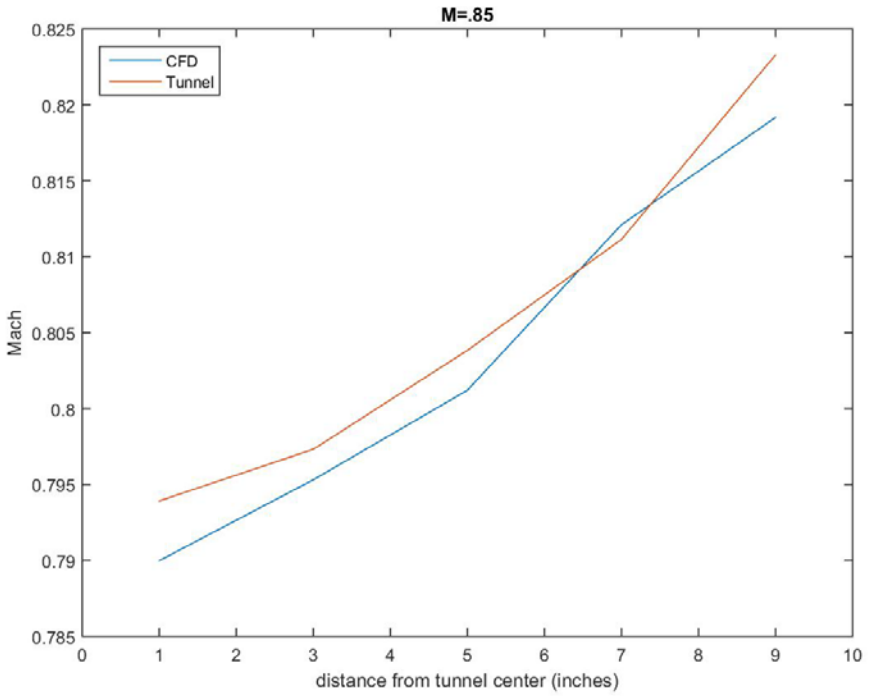




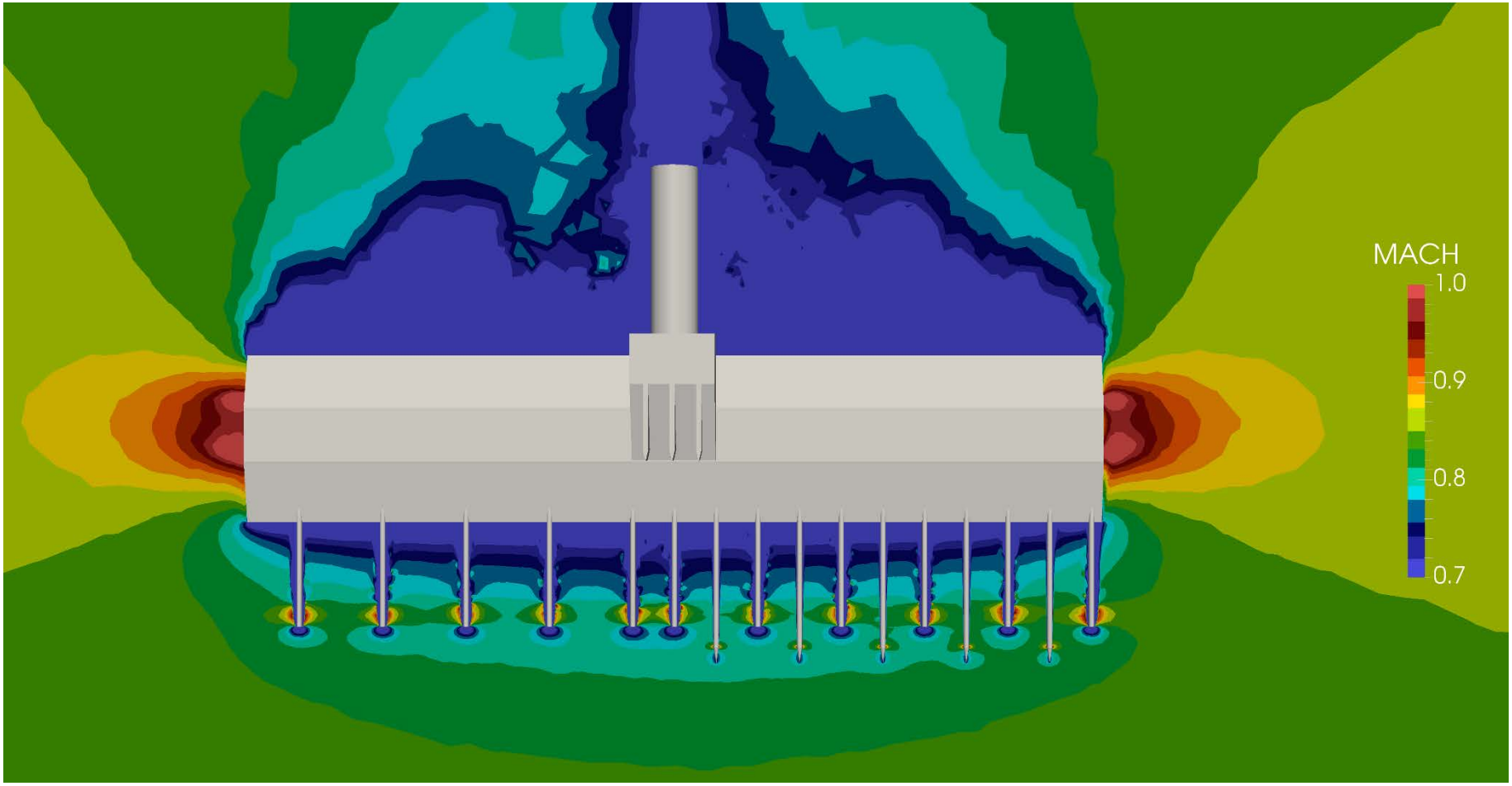
TGF Rake: Results



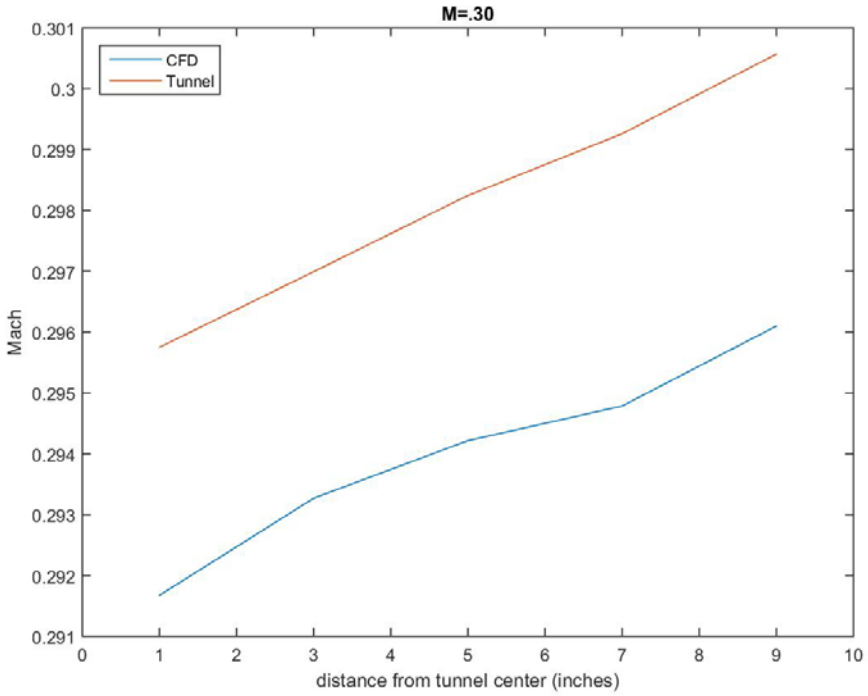


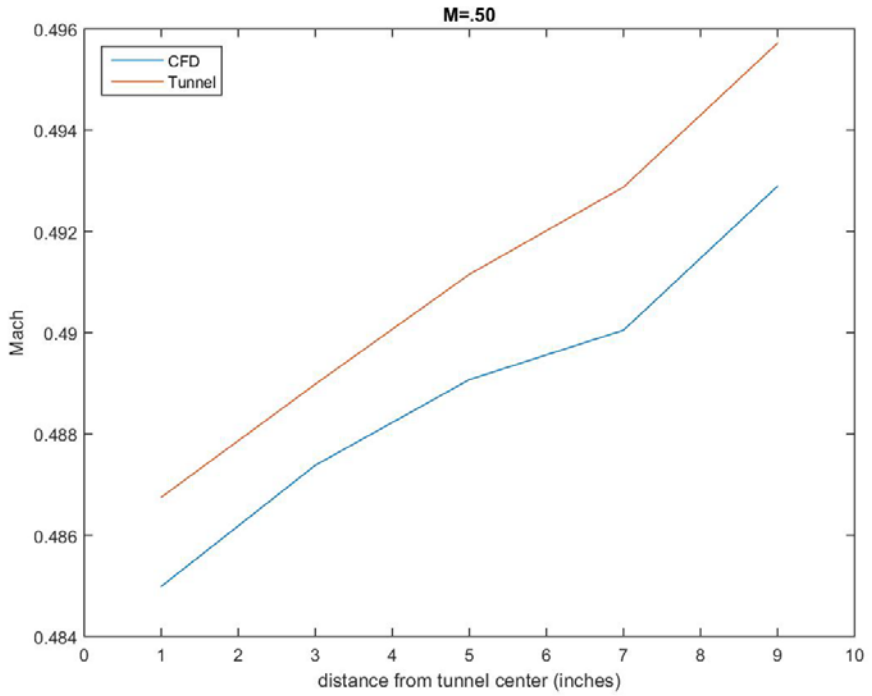


TGF Rake: Results



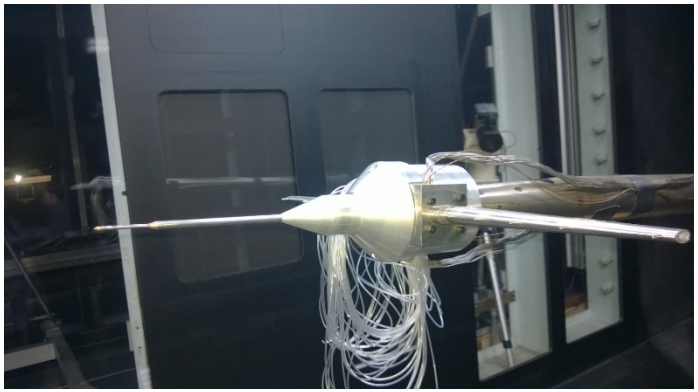
TGF Rake: Results

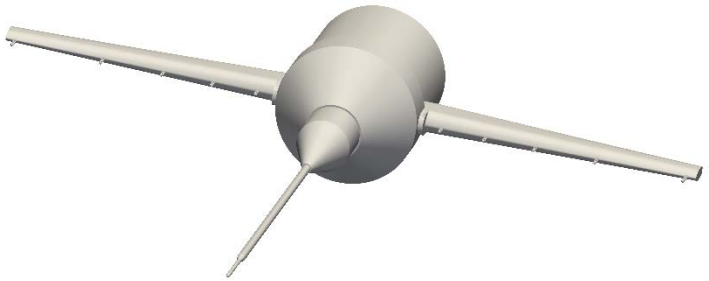




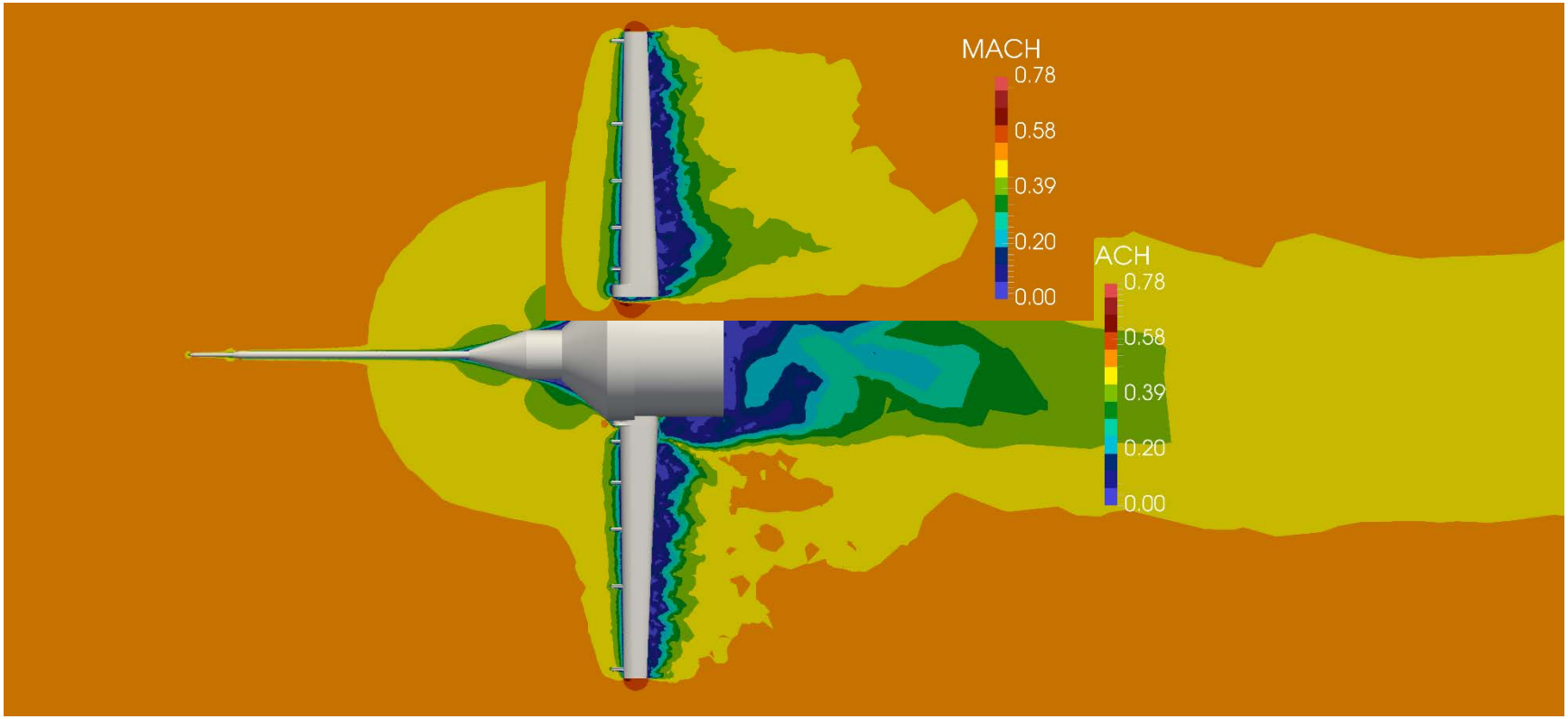
Five-Hole Probe: Setup

- **Customer: Semmelmayer**
- **Engineer: Chang/Buscher**
- **Objective:**
  - **Determine “bias” caused by addition of cone in calibration of 5-hole probes**

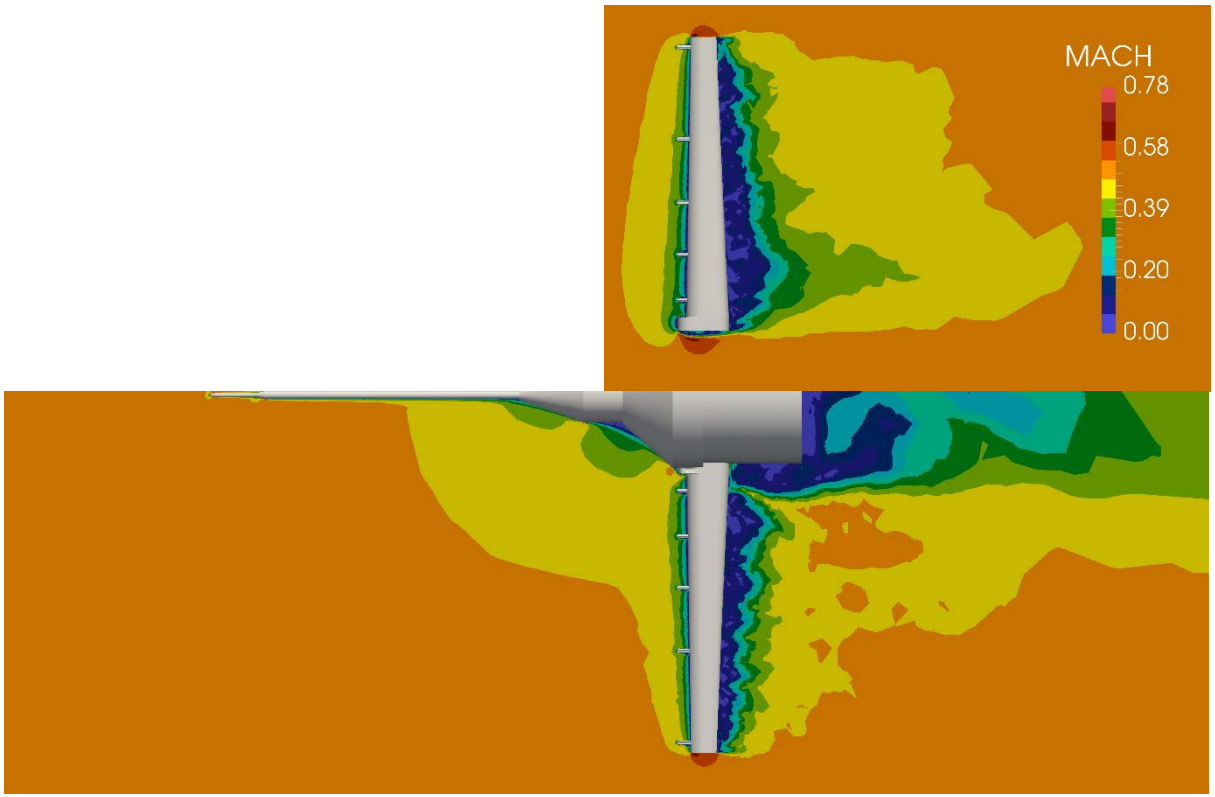




Five-Hole Probe: Results



Five-Hole Probe: Results



Five-Hole Probe: Results