National Aeronautics and Space Administration

NASA Common Research Model Data

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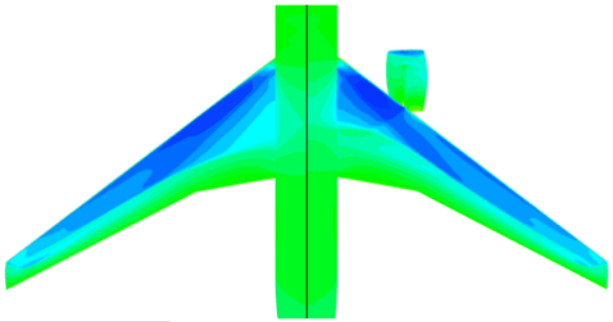
www.nasa.gov

NASA Common Research Model - Origins

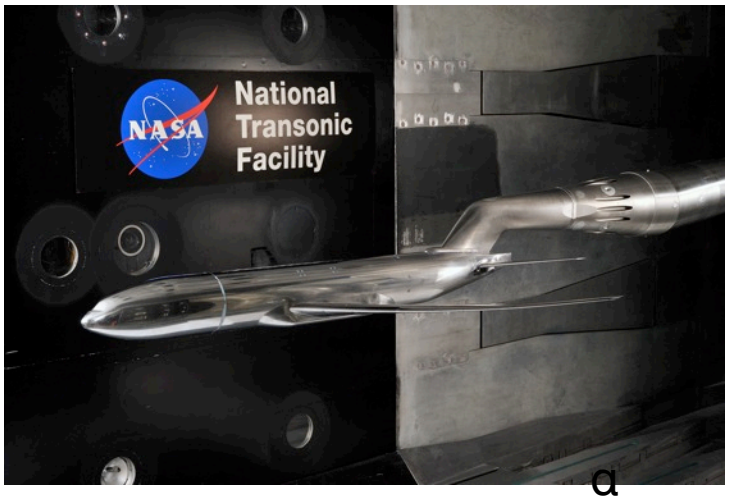
- DPW1, DPW2, DPW3, DPW4 – some consistent (experimental) desires identified
  - Need for a **modern/relevant** and **open/public** civil transport aircraft geometry suitable for applied CFD validation studies
  - Need for traditional and **detailed flow measurements** for CFD validation
    - Force/Moment/Shape/Pressure + skin friction, off body mean and unsteady data
- January 2007 post-DPW3 discussion with US aero leaders at a NASA Aero Technical Working Group meeting
  - Group definition of configuration, design guidelines
  - One “volunteer” at Boeing identified for detailed design/iteration with the group
  - NASA Fundamental Aeronautics/Subsonic Fixed Wing built and funded initial tests



AIAA 2008-6919 Vassberg et al

NASA Common Research Model – Tests

National Transonic Facility at NASA Langley 2010, 2013



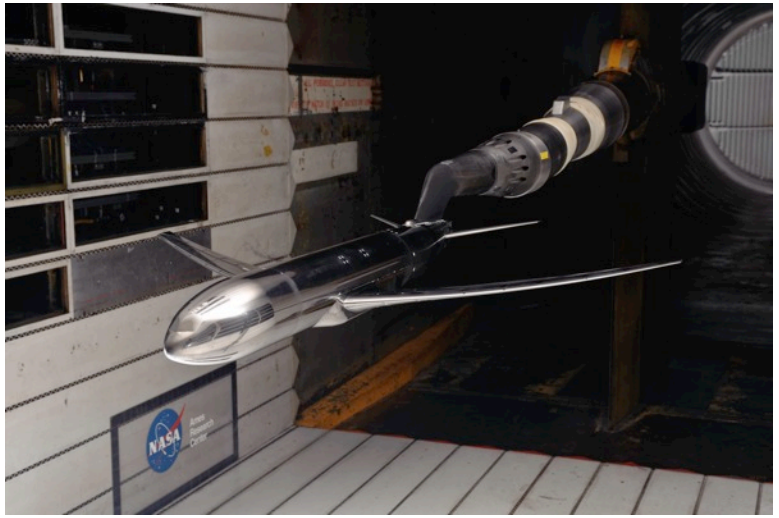
α

- Test Conditions
  - Mach = 0.7 to 0.87
  - Re_c = 5 to 30 million
    - Aeroelastic step at Re_c = 19.8 million
  - α = -3° to +12° for Re_c = 5 million,
    α = -3° to +6° for Re_c = 19.8 and 30 million
  - T = -250°F up to 120°F
  - Five configurations
    - Wing/Body (WB), Wing/Body/Nacelle/Pylon (WBNP), Wing/Body/Tail=0° (WBT0), Wing/Body/Tail=+2° (WBT+2), Wing/Body/Tail=-2° (WBT-2)
  - Wind-on wing twist/deflection measurements taken

- Corrections Applied
  - Classical wall corrections accounting for model blockage, wake blockage, tunnel buoyancy, and lift interference

NASA Common Research Model – Tests

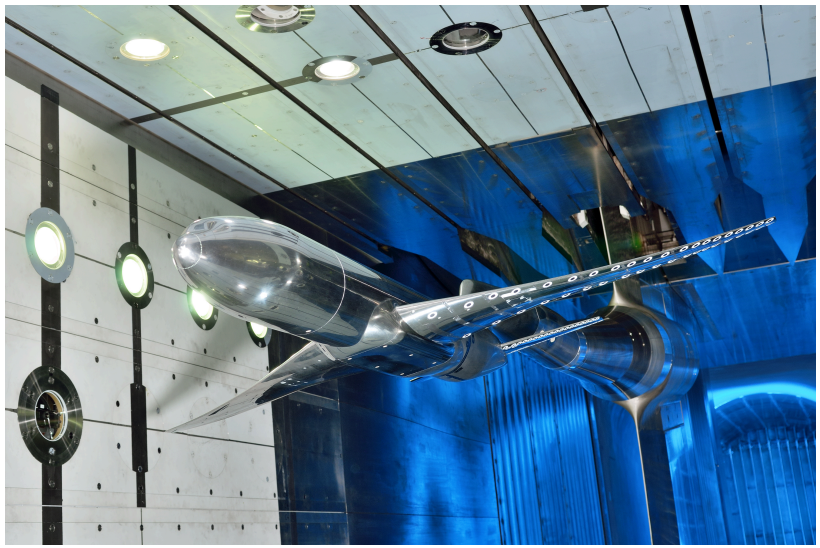
11-ft Transonic Wind Tunnel at NASA Ames 2010



- Test Conditions
  - Mach = 0.7 to 0.87
  - Re_c = 5 million
  - α = -3° to +12°
  - T = 100°F
  - Five configurations
    - Wing/Body (WB), Wing/Body/Nacelle/Pylon (WBNP), Wing/Body/Tail=0° (WBT0), Wing/Body/Tail=+2° (WBT+2), Wing/Body/Tail=-2° (WBT-2)
  - PSP, skin friction, PIV data obtained

- Corrections Applied
  - Classical wall corrections accounting for model blockage, wake blockage, tunnel buoyancy, and lift interference

NASA Common Research Model – Tests



ESWIRP* Consortium
European Transonic Windtunnel in Cologne, Germany 2014

- Test Conditions
  - Mach = 0.7 to 0.85
  - Re_c = 5 to 30 million
    - Aeroelastic step at Re_c = 19.8 million
  - α = -3° to +12° for Re_c = 5 million,
    α = -3° to +6° for Re_c = 19.8 and 30 million
  - T = -249°F up to 83.93°F
  - Only Wing/Body/Tail=0° (WBT0) configuration
  - Wind-on wing twist/deflection measurements taken

- Corrections Applied
  - Corrected for wall interference based on the ETW experimental assessment established in the past

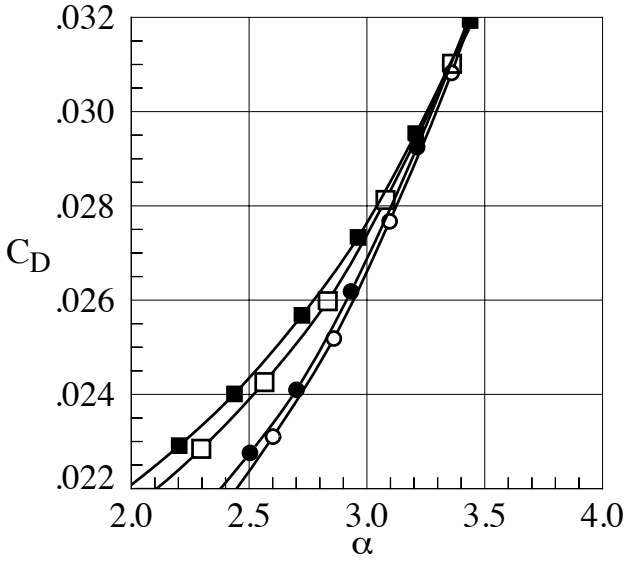
Chart developed with ESWIRP

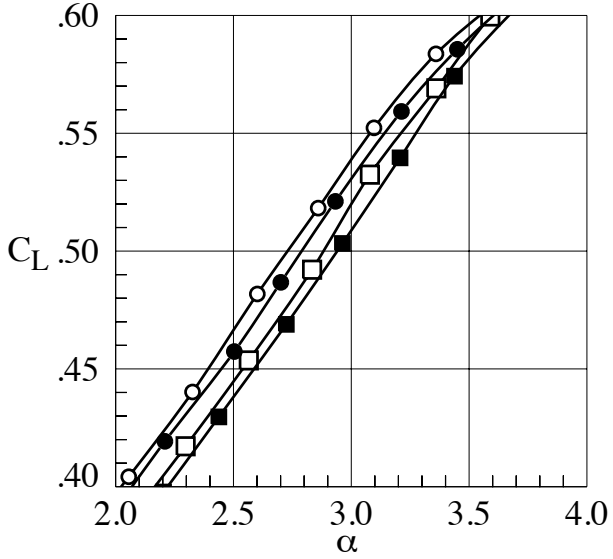
***funded through the European Union FP7/2007-2013 under grant agreement no. 227816 (ESWIRP).**

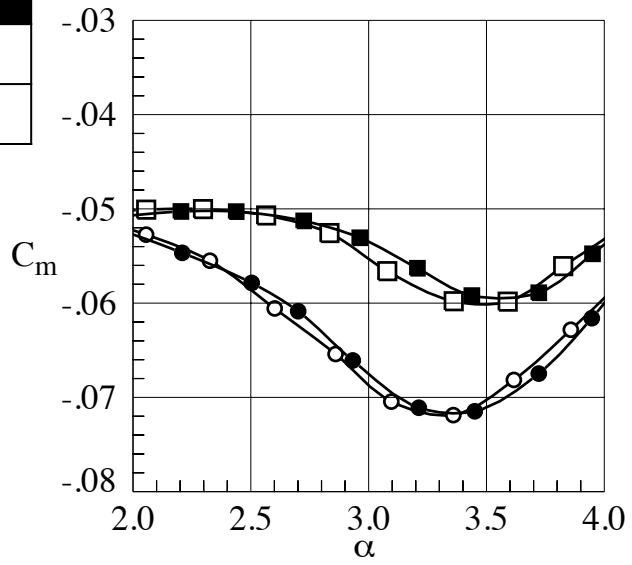
Comparison of NTF and Ames 11-Ft data

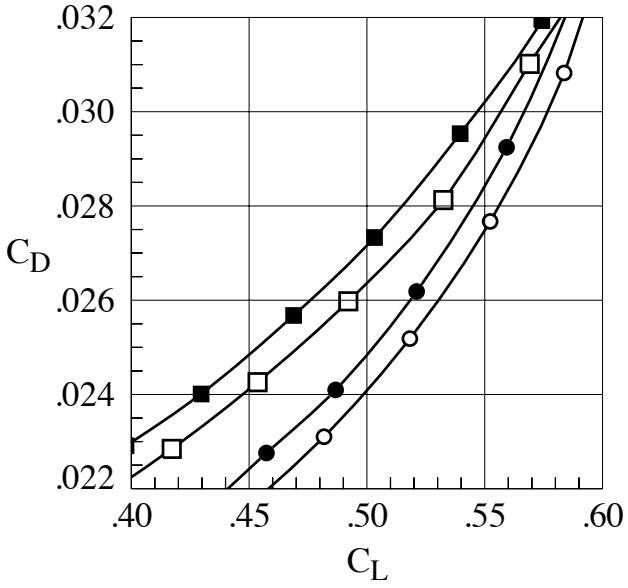
Nacelle/Pylon Increment – M=0.85, $Re_c = 5x10^6$

α=3°	ΔC_L	ΔC_D	ΔC_m
NTF	-0.022	0.0008	0.014
11-Ft	-0.019	0.0007	0.013

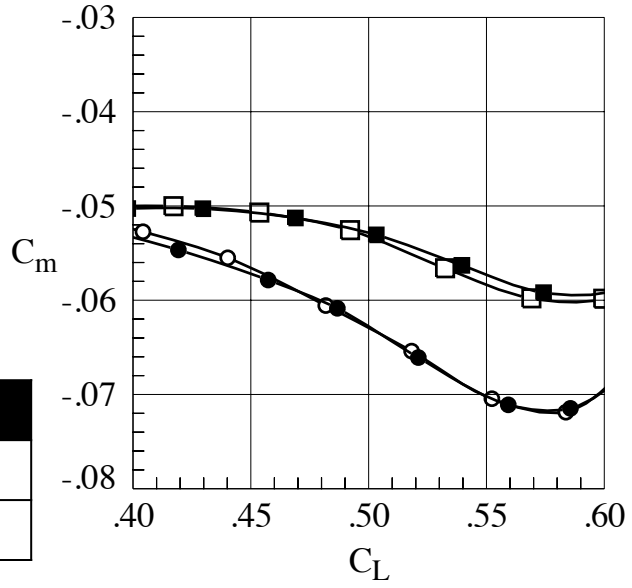






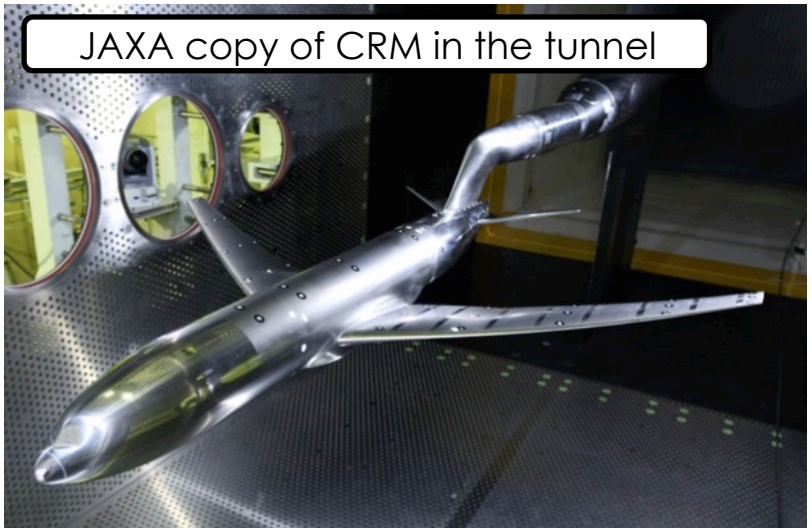


Facility	Config	Run
● NTF Test 197	WB	44.
○ Ames 11ft Test 216	WB	126.
■ NTF Test 197	WBPN	74.
□ Ames 11ft Test 216	WBPN	108.



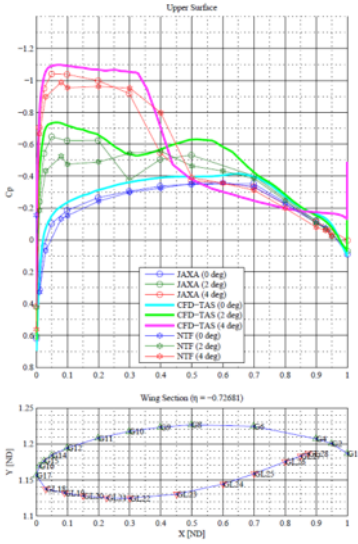
C_L=.5	Δα	ΔC_D	ΔC_m
NTF	0.150	0.0023	0.010
11-Ft	0.151	0.0023	0.010

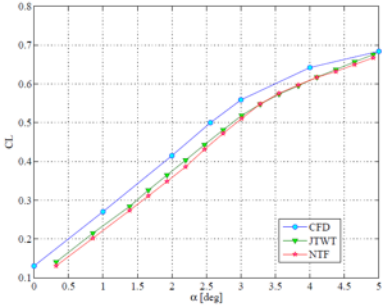
JAXA CRM test

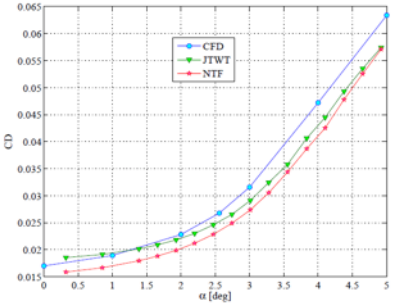


JAXA 2m x 2m transonic wind tunnel

- Closed-circuit and continuously operating facility
- Test section dimensions:
  - 2(w)x2(h)x4.13(l) m
- Reynolds number
  - 2.3M. (NASA NTF: Re=5M, 20M)
- Angle of attack
  - From -2 to 7 deg.







- Stereo PIV
- Static PSP
- Oil-flow

- Force
- Static pressure
- Kulite

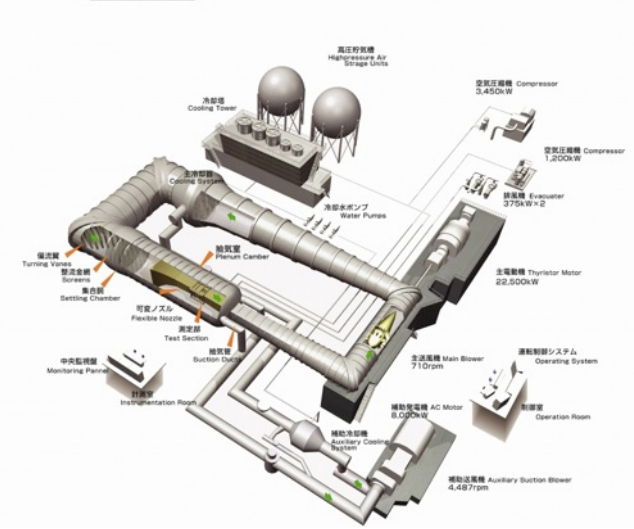


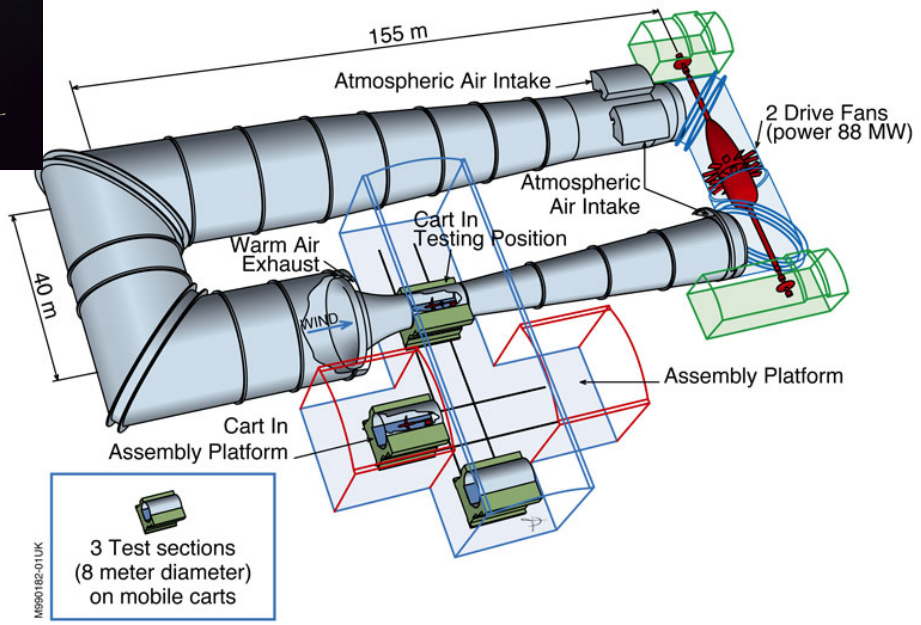
Chart courtesy of JAXA

ONERA LRM test

ONERA LRM

ONERA S1MA wind tunnel

- Continuous flow, atmospheric wind tunnel
- Mach 0.05 to Mach 1
- Angle of attack range = 45 deg
- Test section dimensions:
  - 45 m^2



- WBVH (VTP designed by ONERA)
- All configurations tested
- Mounted on Z-STING
- Real time corrections
- Wing shape rebuilt to have the NTF loaded shape at cruise point

- Force
- Static pressure
- Wing deformation
- Acenaphtene visualizations
- Colored visualizations

Chart courtesy of ONERA

Upcoming Test

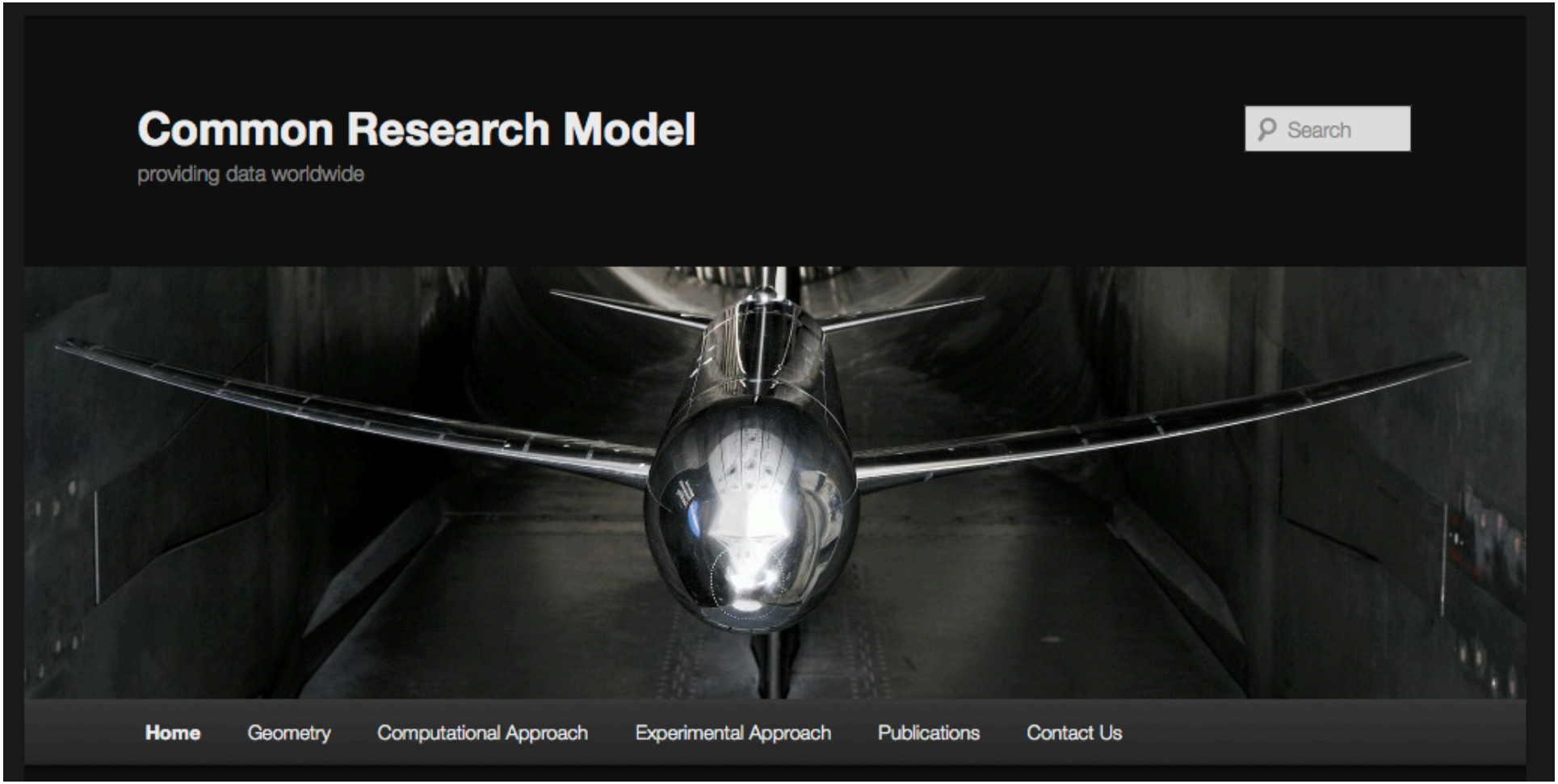
National Research Council 5-ft Trisonic Tunnel in Ottawa Canada FY 2017

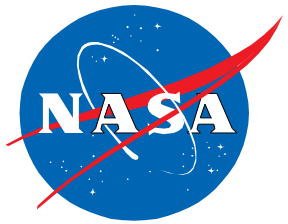
- Pressurized, intermittent flow tunnel
- Half model test using port wing, horizontal tail, and nacelle/pylon of CRM
- Test section dimensions:
  - 1.5m x 1.5m
- Reynolds number
  - 7M (NASA NTF: Re=5M, 20M)

NASA Common Research Model - other

- A CRM high-lift and an active flow control enabled high-lift system are being developed
- NASA and others are using the CRM as a basis for structural and aero/ structural design optimization
- JAXA has performed 2D CRM airfoil tests
- Several Universities are using the CRM as a part of design classes

http://commonresearchmodel.larc.nasa.gov/




NASA