FLOW STABILTY and FLOW CONTROL
Polish-Canadian cooperation 1991-2009

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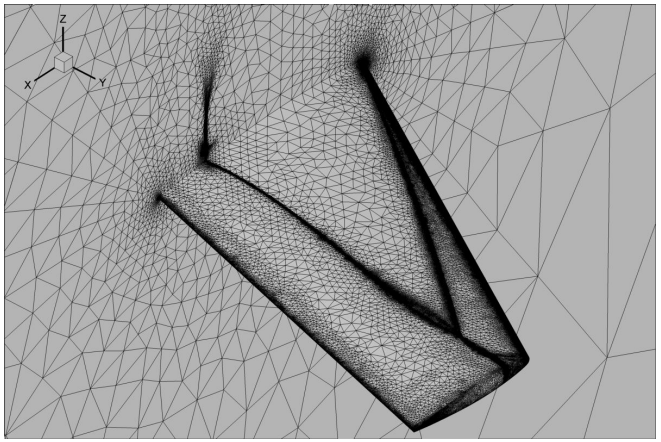
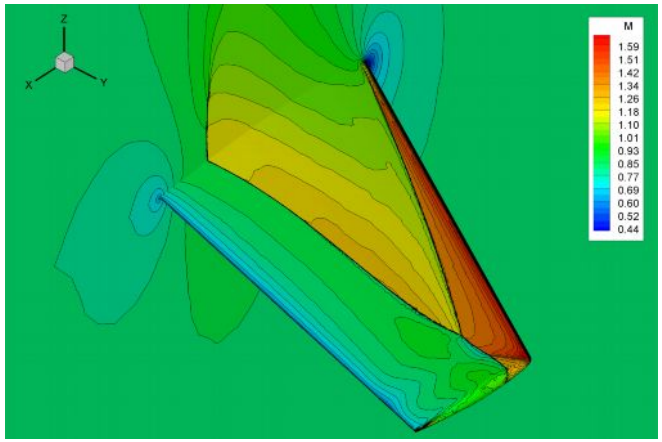
Rzeszów 2.03.2009

Outline of the presentation

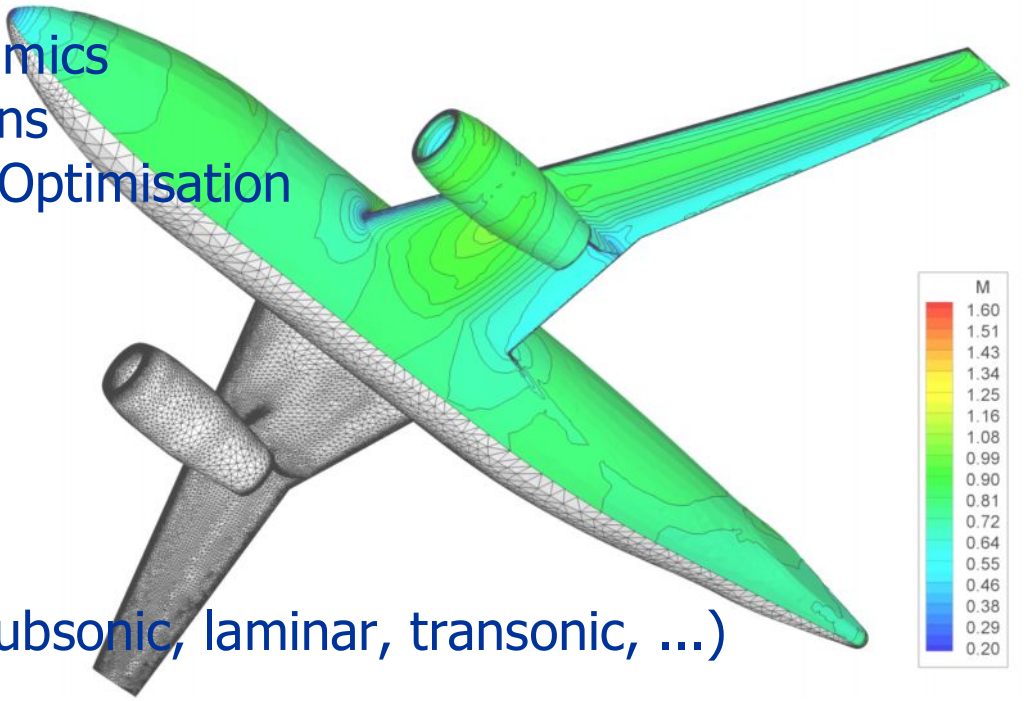
- Department of Aeodynamics + C-CFD Centre of Excellence for Computational Fluid Dynamics
- Polish-Canadian Cooperation





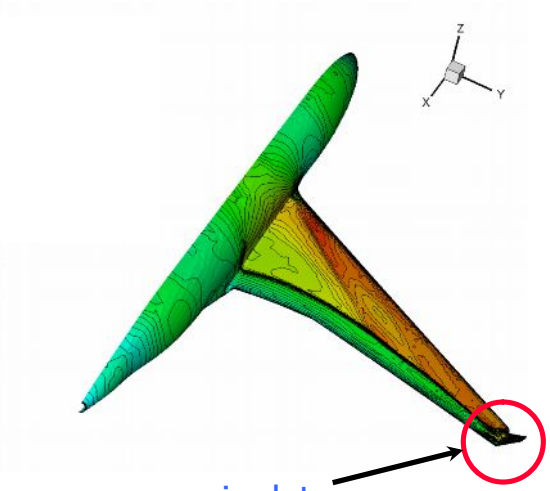
Department of Aerodynamics

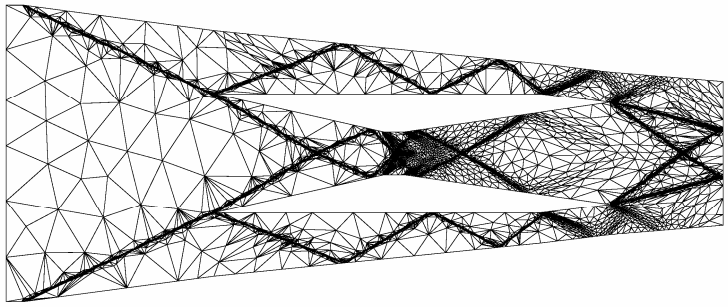
- Exists since 1927
- Centre of Excellence for Computational Fluid Dynamics (2002)
- Research:
  - Computational Fluid Dynamics
  - Experimental Investigations
  - Aerodynamic Design and Optimisation
- Staff:
  - 5 full Professors
  - 8 researchers with Ph.D.
  - 4-6 Ph.D. students
  - 4 technicians
- Equipment
  - Range of Wind tunnels (subsonic, laminar, transonic, ...)
  - Own computing centre
    (3 PC clusters)



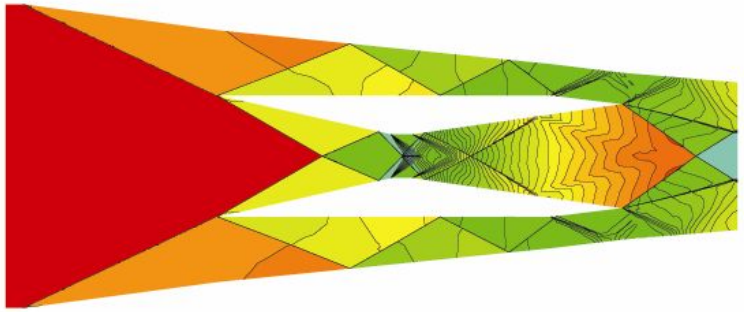
Recent research subjects in CFD

- High-order methods for compressible flows
- Adaptive mesh generation (ADIGMA)
- Design and optimisation for aeronautic configurations (NACRE) – genetic algorithms and adjoint equation approach (FLOWHEAD)
- Parallelisation of algorithms
- Flow stability, DNS
- Flow control



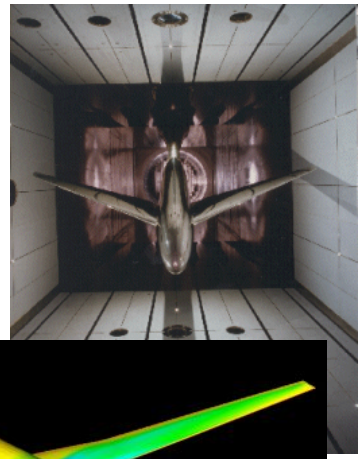


Adapted mesh in the scramjet

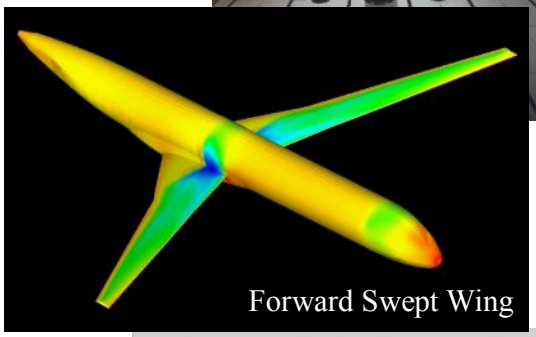


flow in the scramjet

European projects



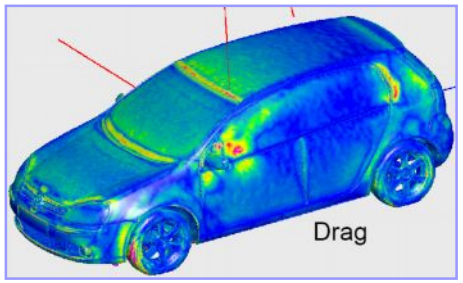
HiReTT
1999-2003



ADIGMA
2006-2009

M-DAW

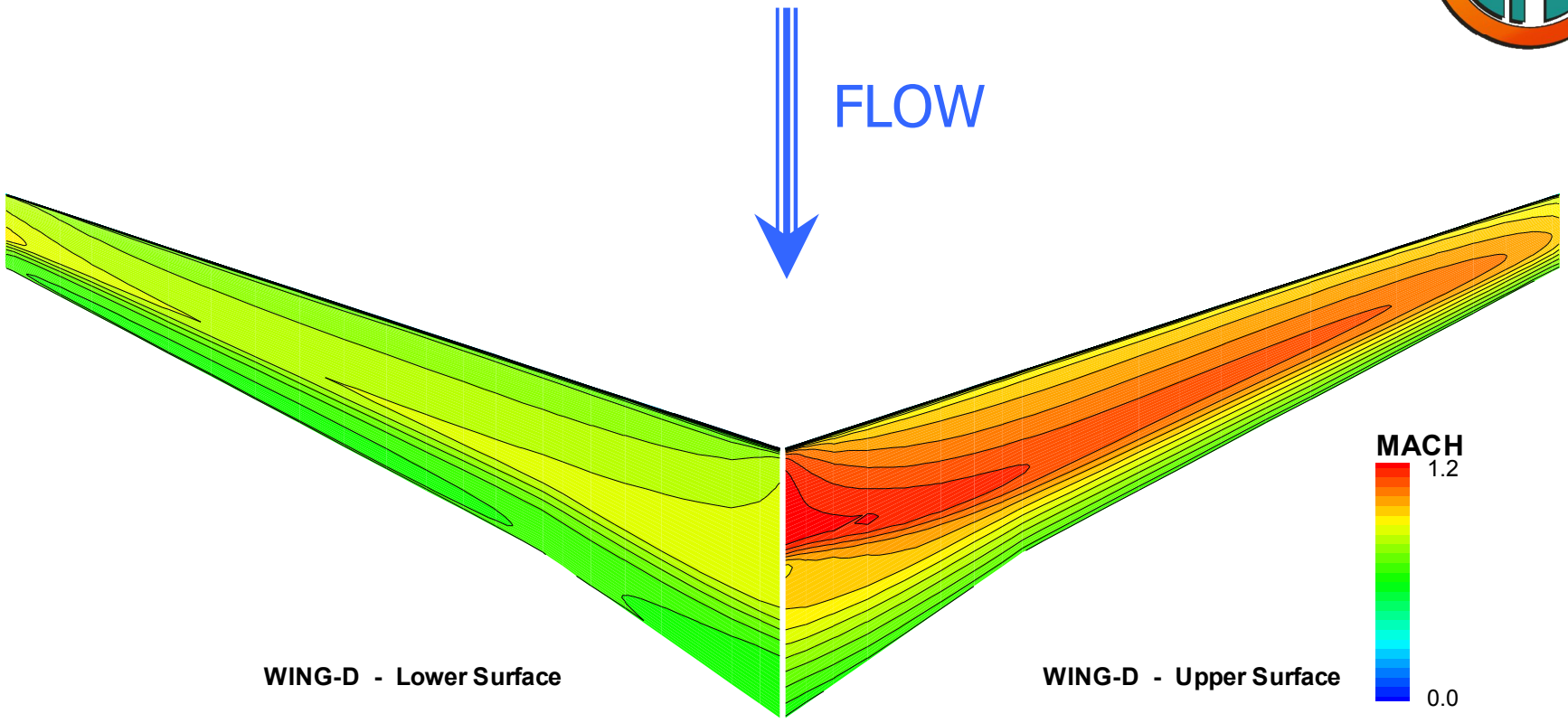
NACRE
2005-2009



FLOWHEAD

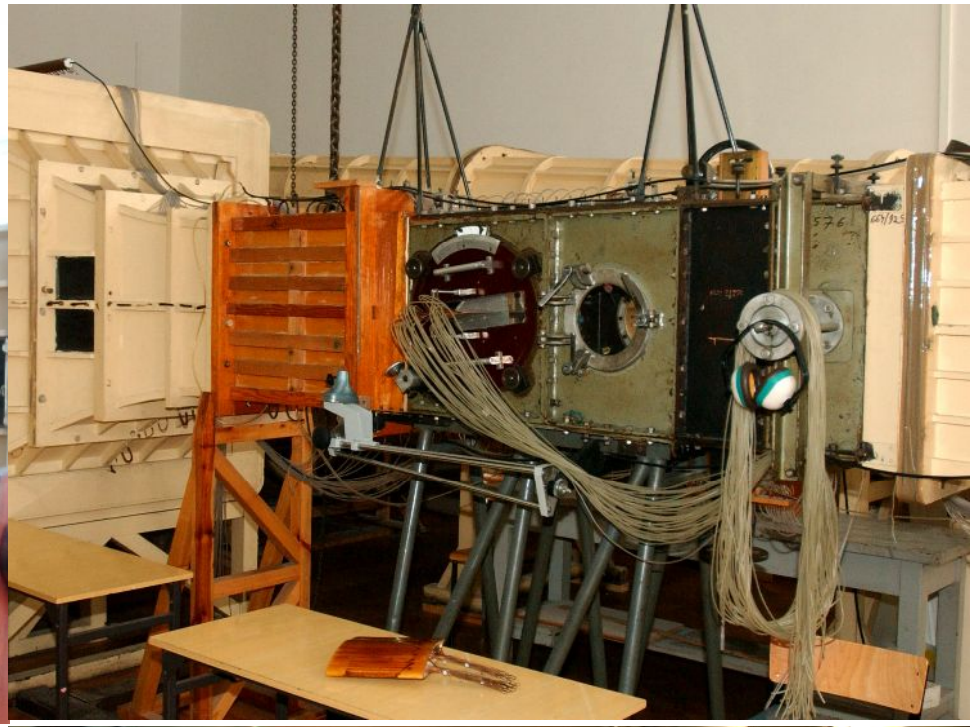
2008-2011
Fluid **O**ptimisation **W**orkflows for
Highly **E**ffective **A**utomotive **D**evelopment Processes

NACRE – Laminar FWS Optimisation



15 DC reduction possible via laminarisation
(Design WUT + DLR)

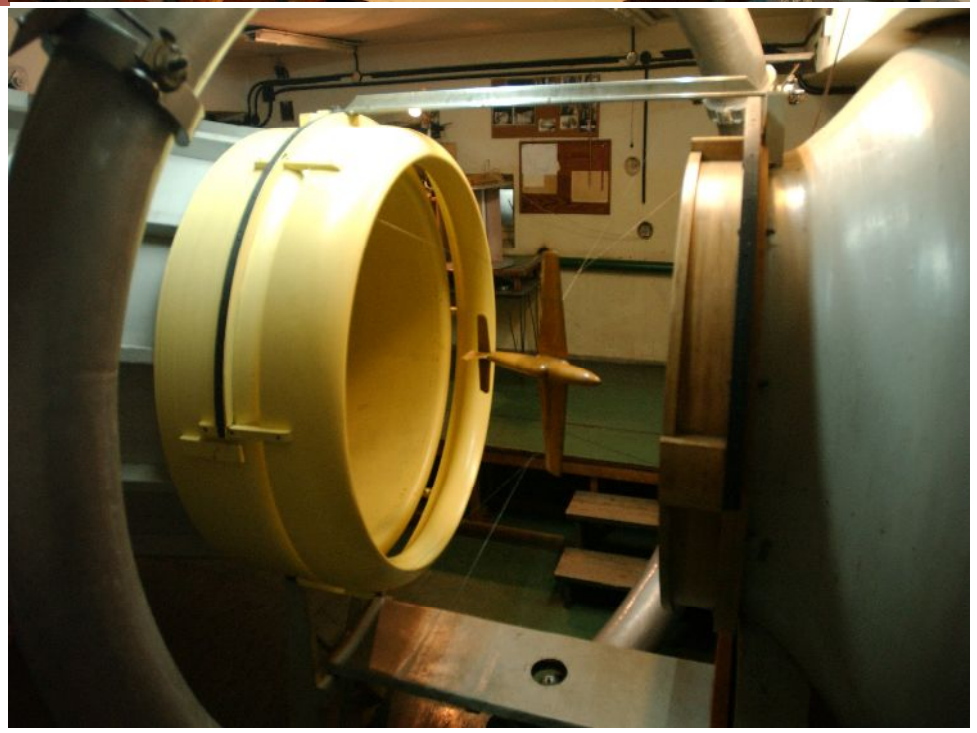

Diana - 2
P - 3697

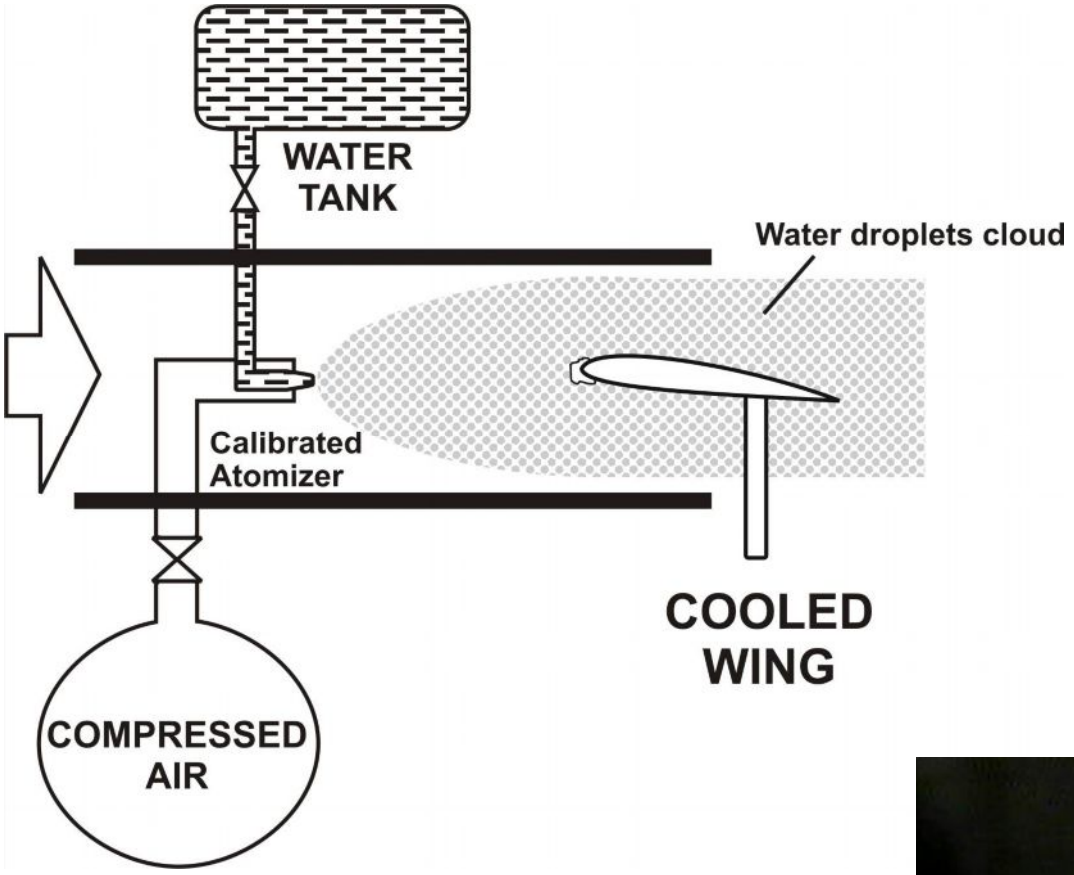


Experimental facilities

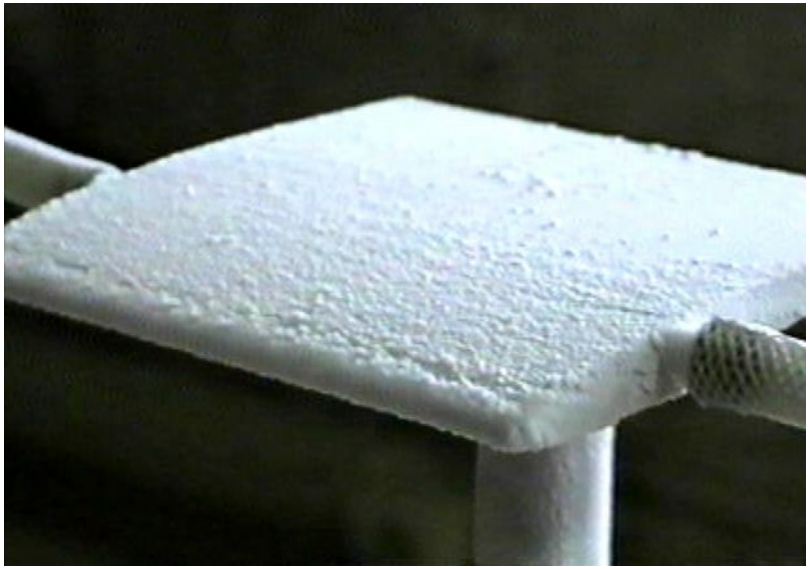
Range of wind-tunnels:

- Laminar
- Transonic
- Low Speed



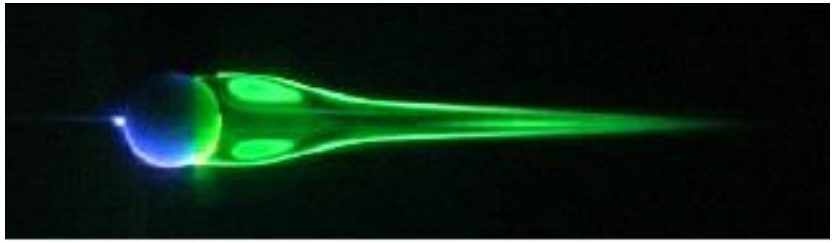


Simulation of Ice Accretion

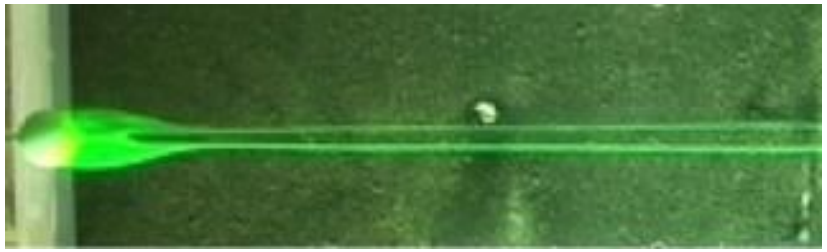


Low Reynolds number flow stability
(in cooperation with ESPCI Paris)

K. Gumowski, J. Miedzik, S. Gujon-Durand, J.E. Wesfreid

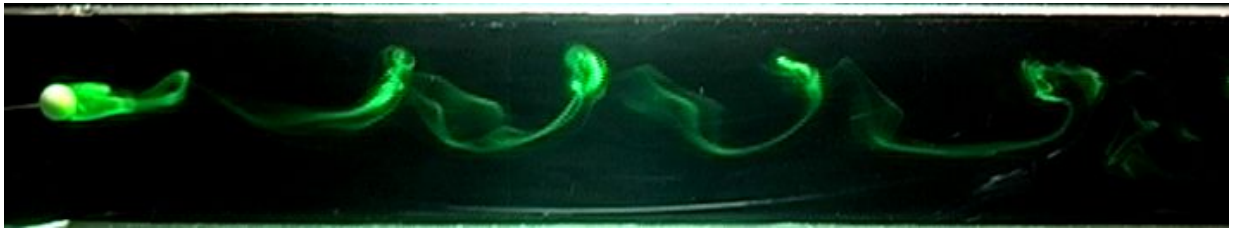


Re<212 axisymmetric



212<Re<274 planar-symmetric

Re>274 planar-symmetric
Nonstationary + hairpin shedding



Re>500 irregular
hairpin shedding

POLISH-CANDIAN COOPERATION 1991-2009

The University of Western Ontario

WARSAW UNIVERSITY OF TECHNOLOGY

McMaster University

Inspiring Innovation and Discovery

Cooperation

- J.M. Floryan, University of Western Ontario (coop. since 1992)
  - J. Rokicki (NSERC International Postdoctoral Fellowship 1992-1994)
  - J. Szumbarski (NATO Postdoctoral Fellowship 1996-1998)
- B. Protas, McMaster University (since 2004)

Present Cooperation Topics

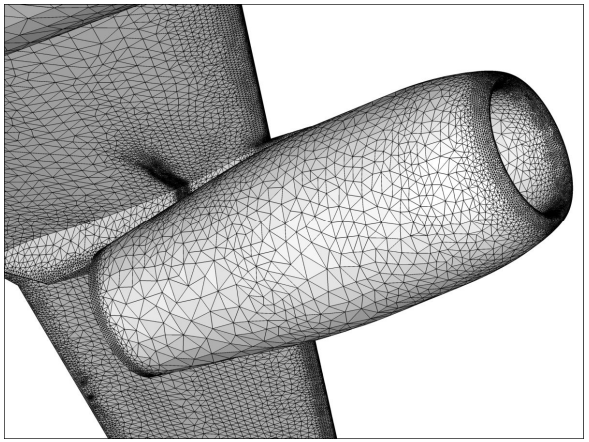
- Flow Stability and Transition to Turbulence (Effect of Roughness)
- Active and Passive Flow Control
- Numerical Methods for low-Reynolds flows
- Flow optimisation with adjoint-based techniques

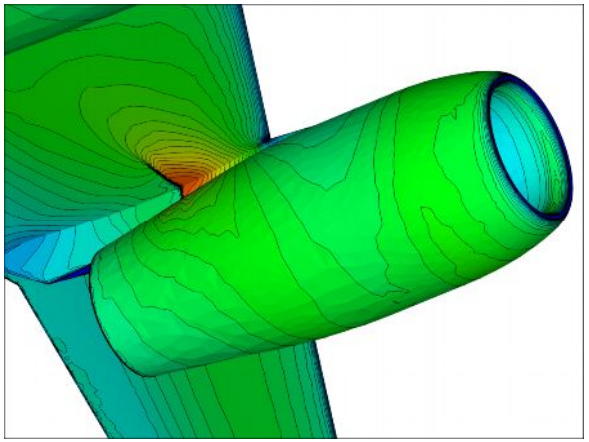
Shared Hierarchical Academic Research Computing Network

SHARCNET™

Publications

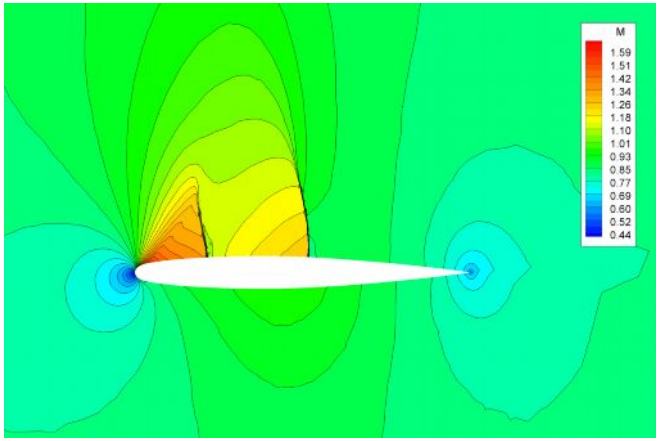
- Over 15 full journal papers, incl.:
  - Journal of Fluid Mechanics (2)
  - Journal of Computational Physics (2)
  - Computer & Fluids (2)
  - Physics of Fluids (1)
- Over 30 papers in conference proceedings





Topics of future cooperation

- Advanced Simulation Methods for Active Flow Control
- Active Flow Control to Prevent Transition to Turbulence (MEMS, synthetic jets)
- Development of Novel Superhydrophobic Coatings to Prevent Ice Accretion
- Morphing Aircraft Wing



THANK YOU FOR YOUR ATTENTION