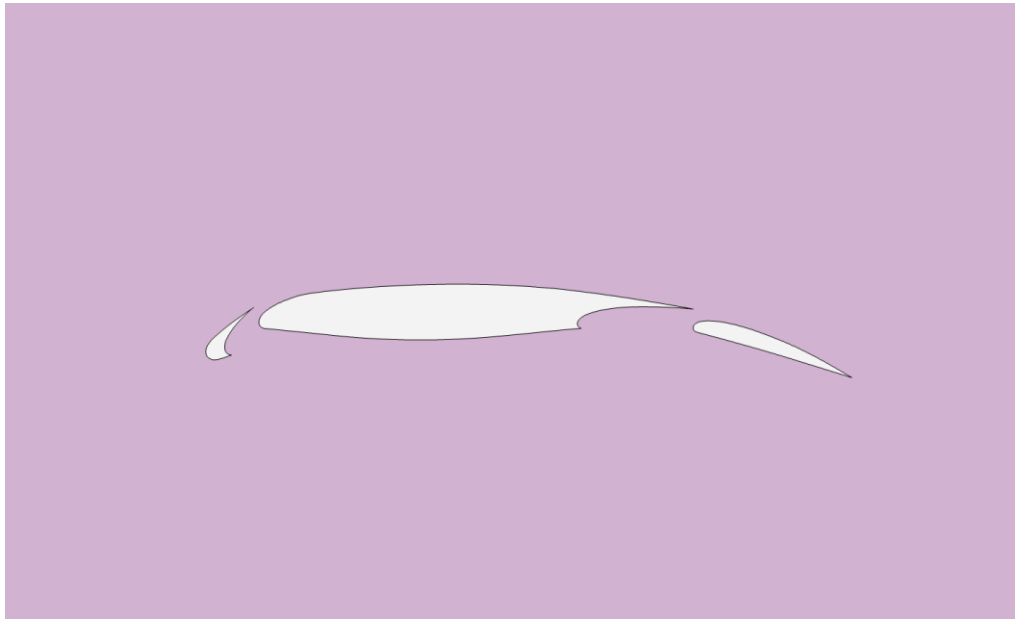
Problem definition

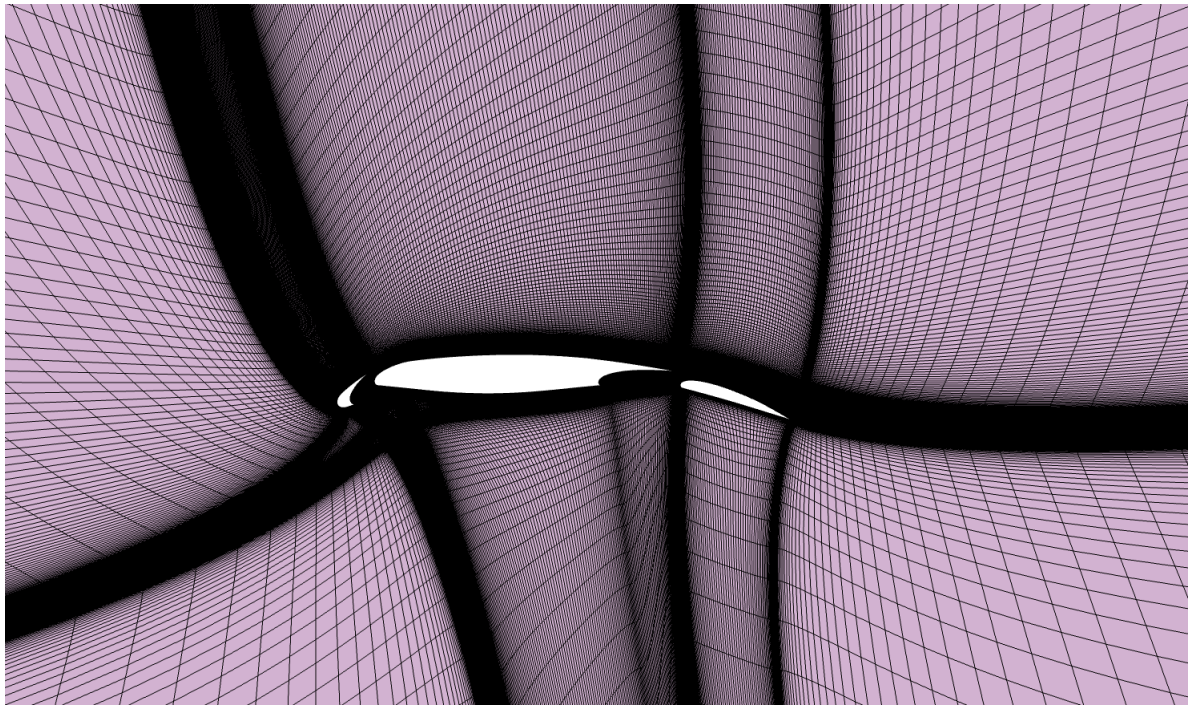
Transitional Flow Simulation Over the Three-element Airfoil NHLP2D

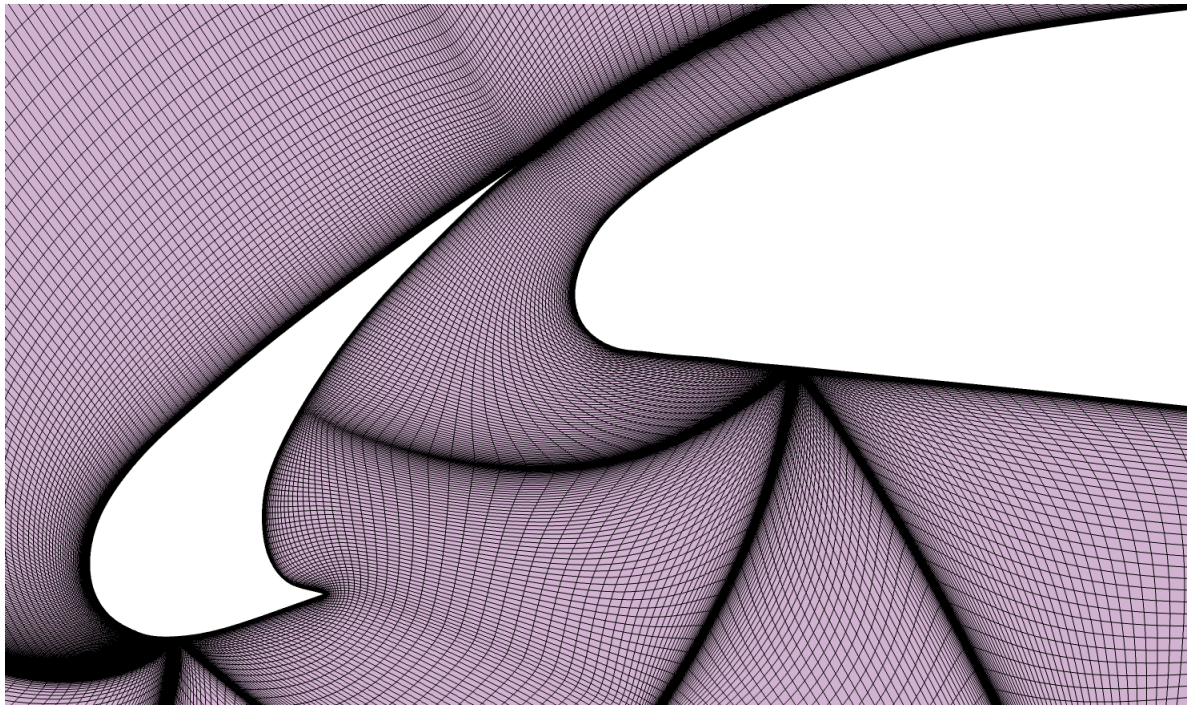


- Another transition validation case related to aeronautical applications.
- This is a hard as it can get.
- This case has plenty of experimental and numerical data available.
- **A few references:**
  - I. Moir. Measurements on a Two-Dimensional Airfoil with High-Lift Devices, AGARD AR 303. Aug 1994. Case A2.A. M. Savill. Some recent progress in the turbulence modeling of bypass transition. Near-Wall Turbulent Flows, 1993.
  - T. Nelson, P. Godin, S. De Rango, D. Zingg. Flow Computations for a Three-Element Airfoil System, Canadian Aeronautics and Space Journal, Vol. 45, No. 2, June 1999.
  - S. De Rango, D. Zingg. Higher-Order Spatial Discretization for Turbulent Aerodynamics Computations, AIAA Journal, Vol. 39, No. 7, July 2001.
  - I. Fejtek. Summery of Code Validation Results for a Multiple Element Airfoil Test Case, AIAA.

Problem definition

Geometry and mesh

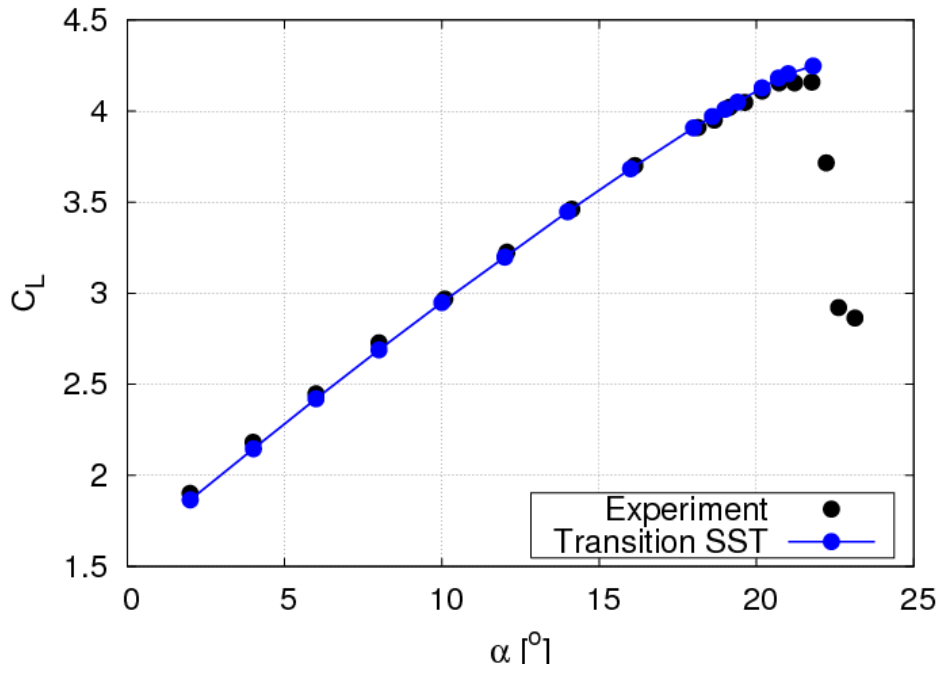


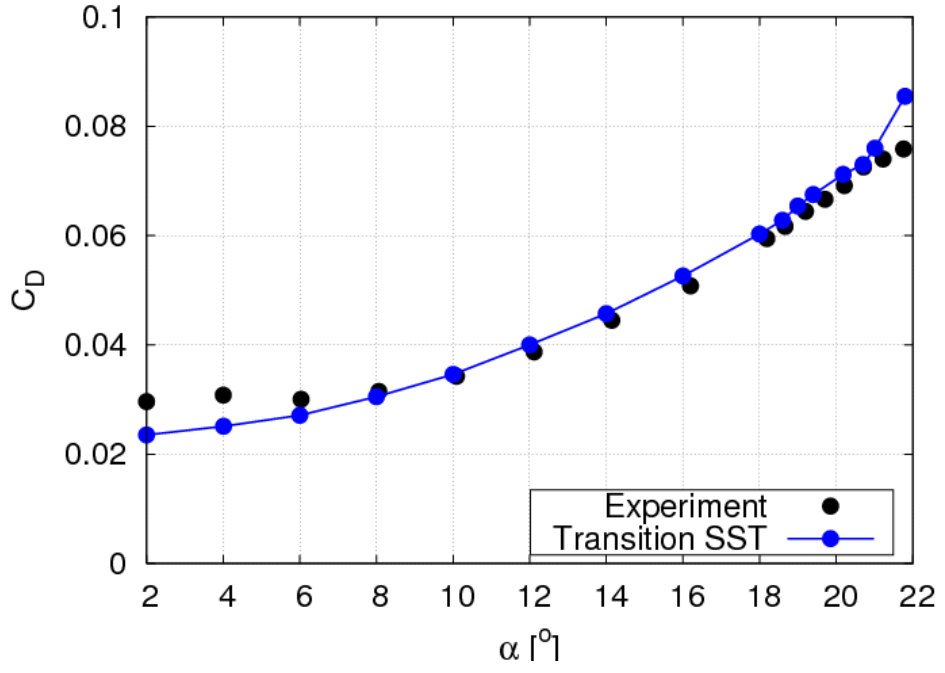


- We will run this case at a Reynolds number equal to 3 500 000.
- The Mach number is low, nevertheless we will use a compressible solver.
- We will run at an angle of attach of 20.18°, very close to the maximum lift coefficient..
- You are invited to run the case at different angles of attack and try to reproduce the lift and drag polars.
- You can also run the case using traditional turbulence models and compare the outcome.

Problem definition

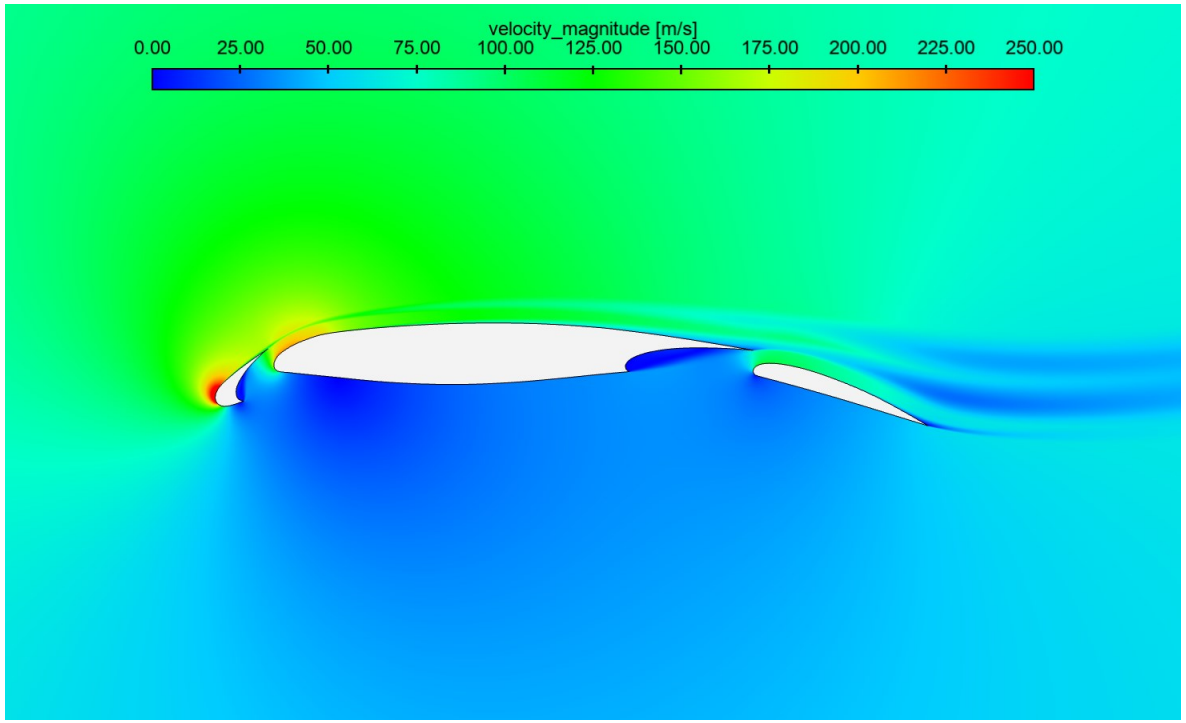
Geometry and mesh



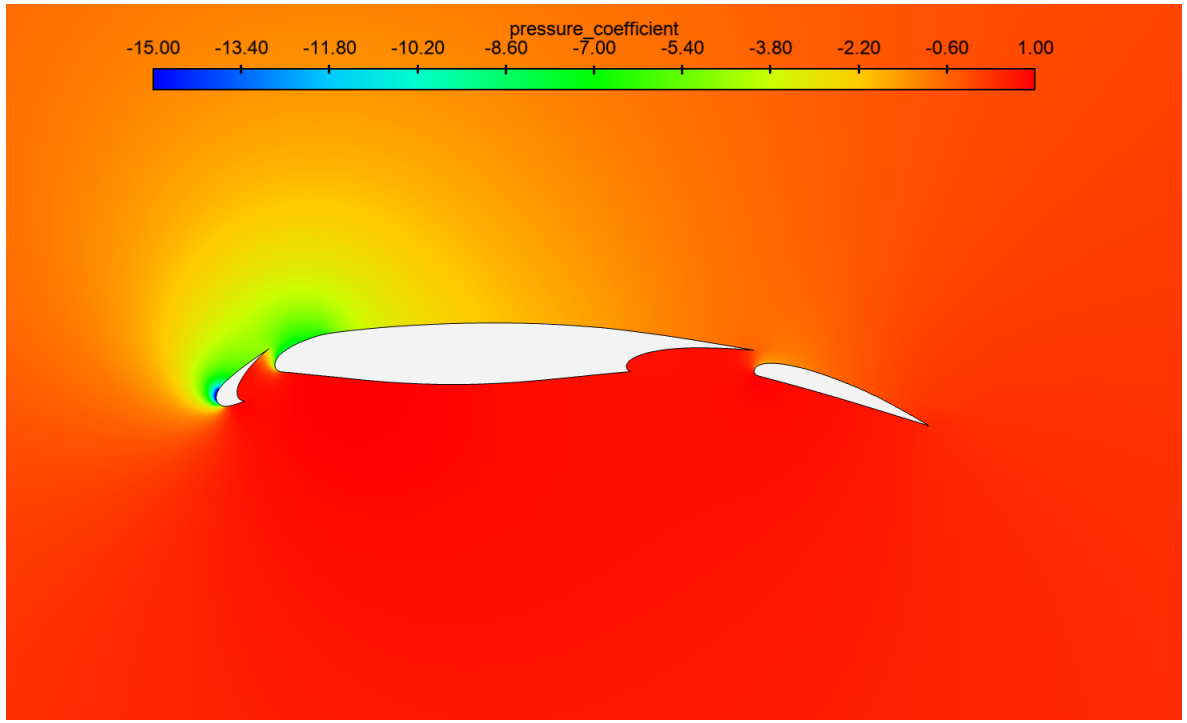


- Capturing the maximum lift coefficient and the stall pattern (abrupt stall in this case) is very challenging in CFD.
- This behavior is better capture using transition turbulence models.

Qualitative and quantitative results

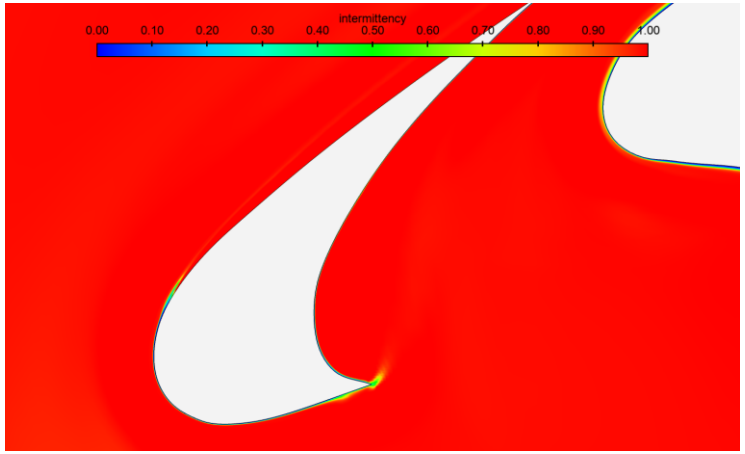


Pressure contours

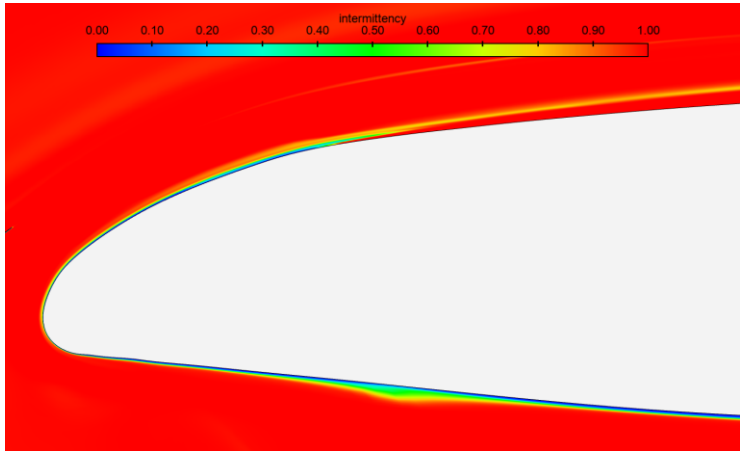


Velocity magnitude contours

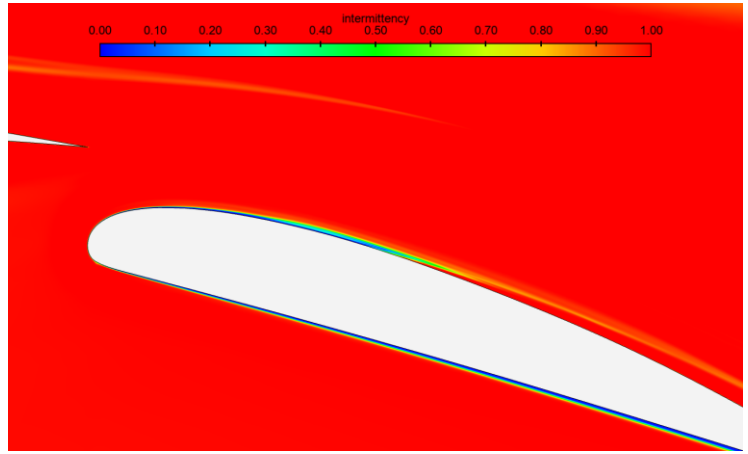
Qualitative and quantitative results



Slat



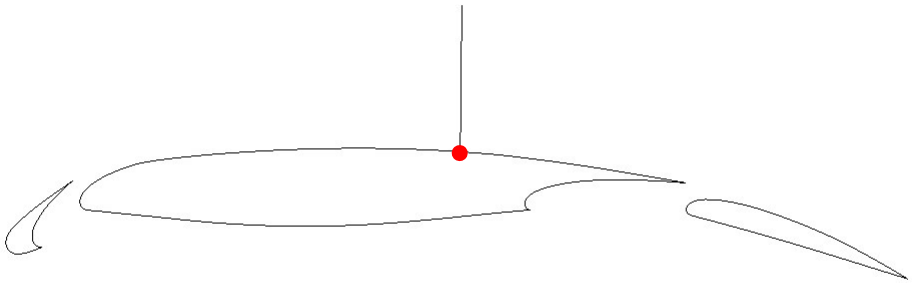
Main airfoil



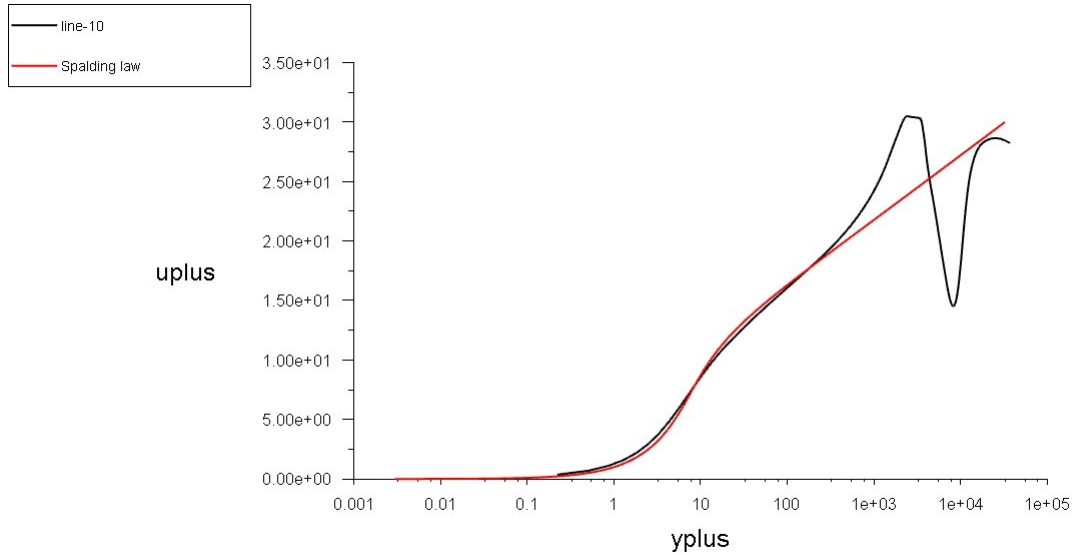
Flap

Plot of intermittency contours
Values equal to zero indicate laminar flow.

Qualitative and quantitative results

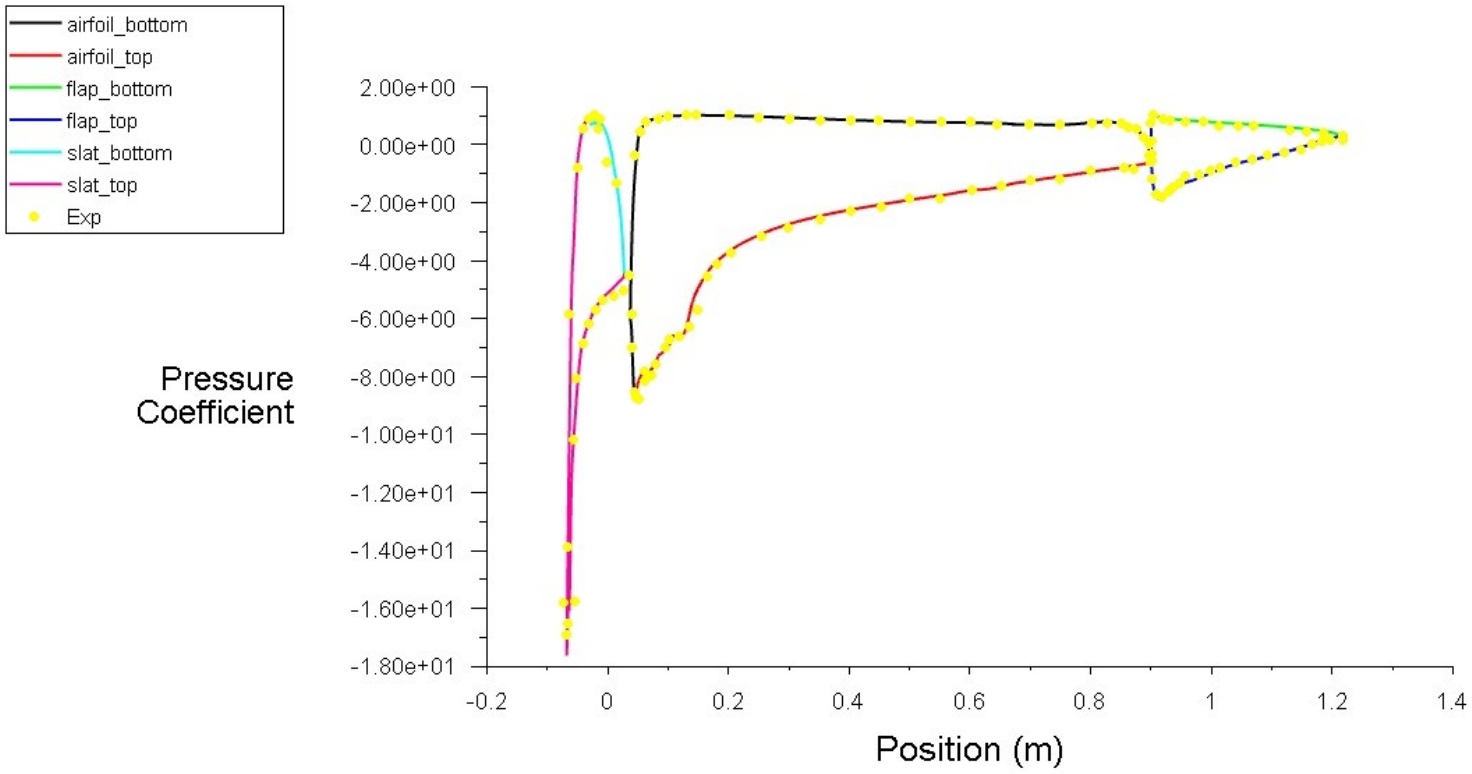


Sampling location



Non-dimensional velocity profile at sampling location

Qualitative and quantitative results



Pressure coefficient – Numerical results and experimental results