

Demo: 2D laminar plane channel flow

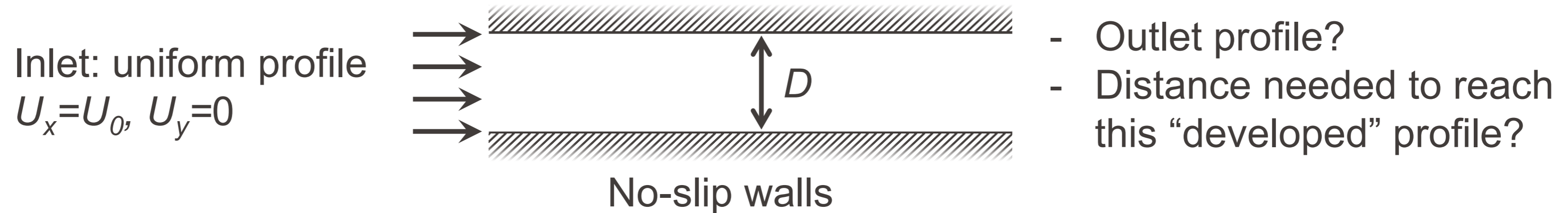
Numerical Flow Simulation

Edouard Boujo

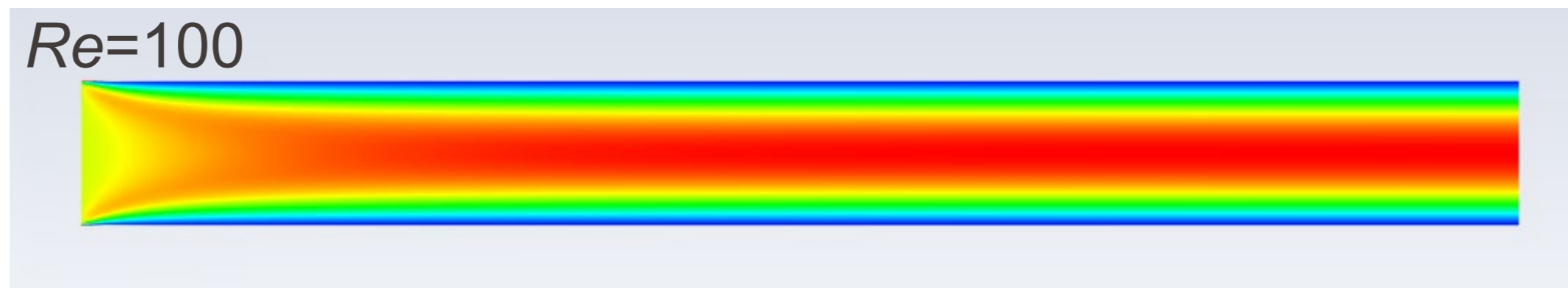
Fall 2023

2D laminar plane channel flow

- Sketch:

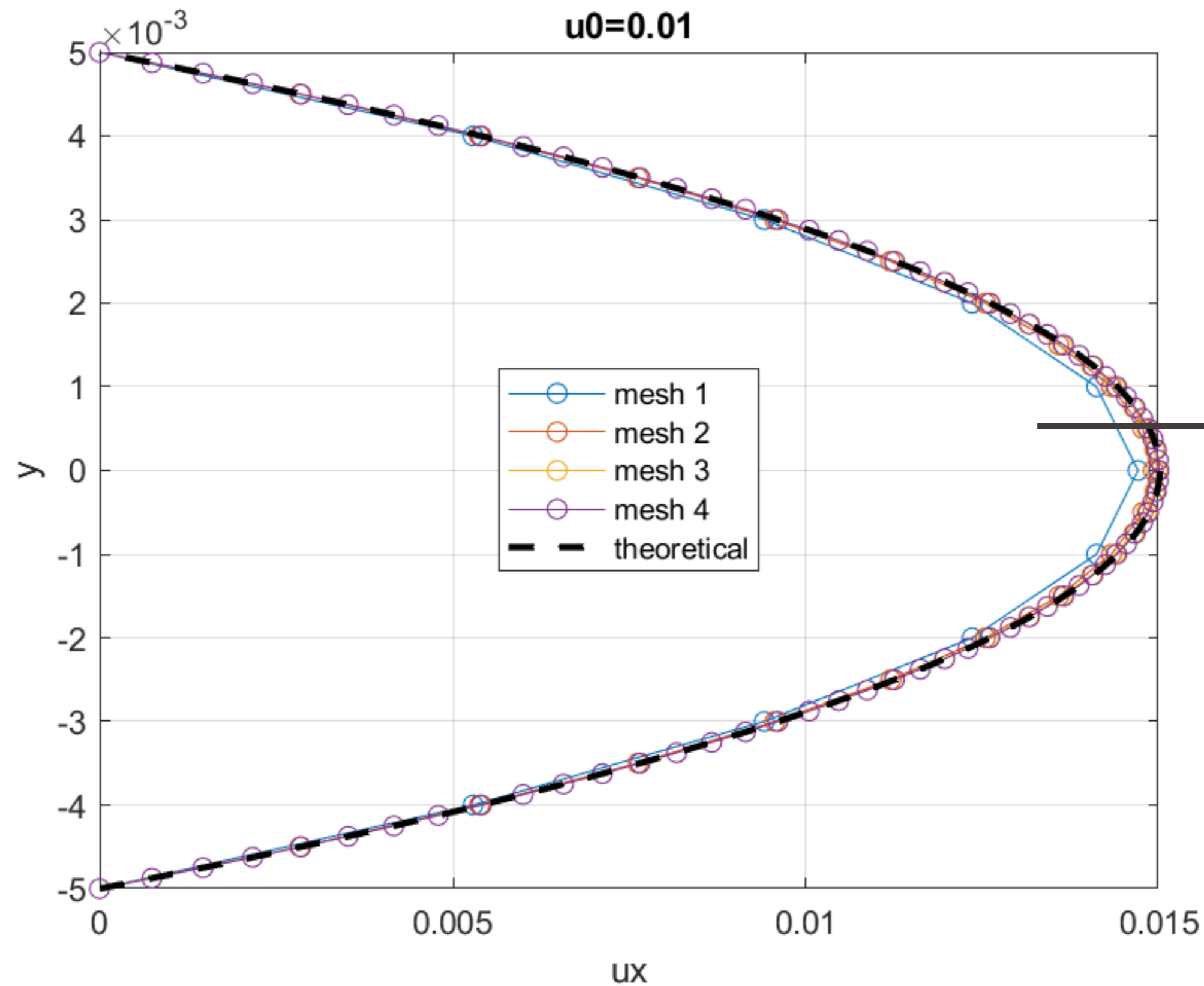


- Operating conditions: laminar regime ($Re < \text{approx. } 1000$)
- Dimensions and physical properties: e.g. $D=1$ cm, $U_0=1$ cm/s, water $\nu \approx 1e-6$ m²/s ($\mu \approx 1e-3$ kg/(m.s), $\rho \approx 1000$ kg/m³) $\rightarrow Re=U_0 \cdot D/\nu=100$



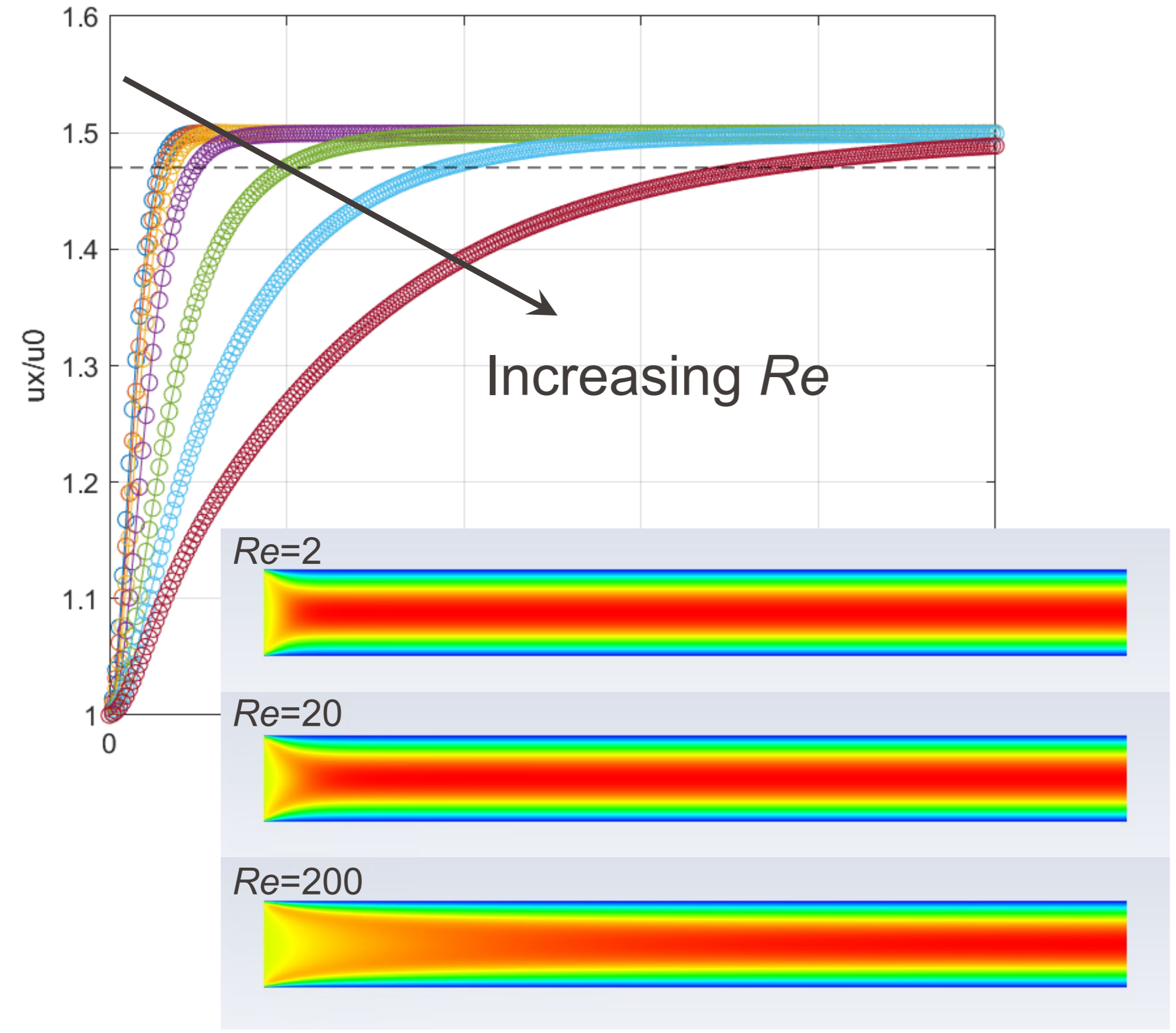
Effect of mesh size

- As the mesh is refined, the numerical velocity profile at the outlet gets closer to the theoretical fully-developed profile (Poiseuille, parabolic):



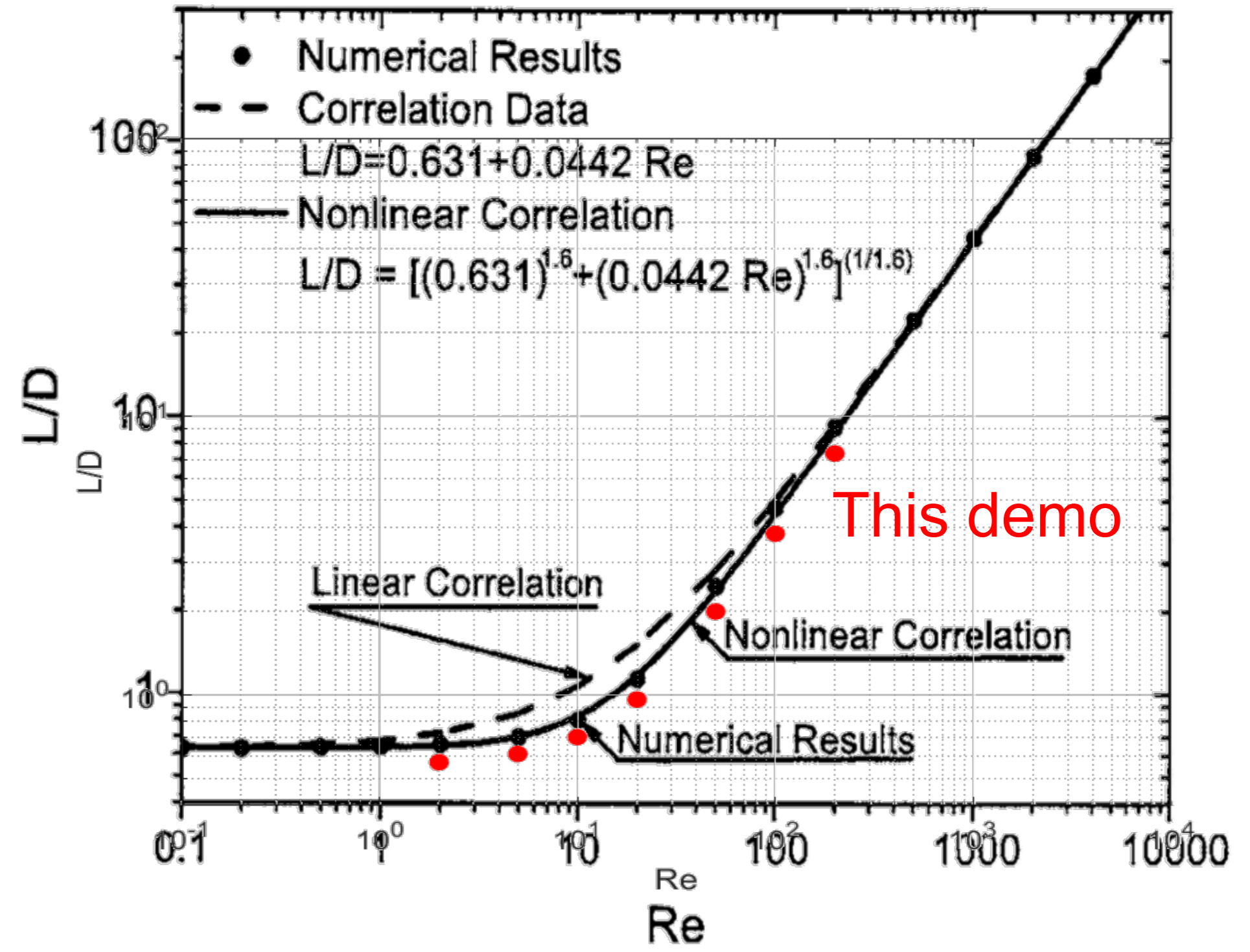
Effect of Reynolds number

- Centerline velocity:



Numerical Flow Simulation

- “Entry length” = distance needed to reach fully-developed profile:



Durst, Ray, Ünsal and Bayoumi, J. Fluids Eng., 2005