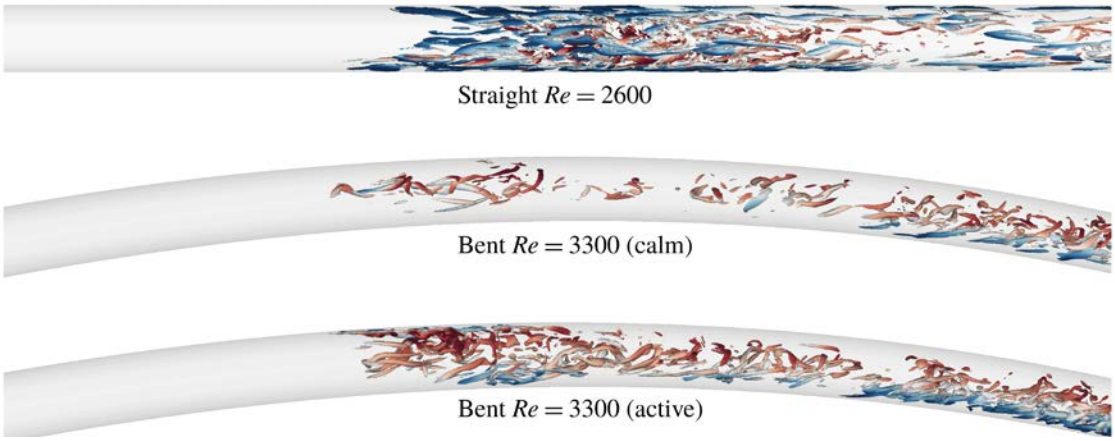
Bachelor thesis:

Turbulence transition in pulsatile pipe flow with small curvatures

The presence of turbulence in the human aorta has been historically linked with cardiovascular diseases [1]. It is thus of the interest to understand how aortic flows can transition to turbulence and how turbulence behaves once it is triggered. However, cardiovascular flows are difficult to measure and to model. This is because the flow is influenced by many complex features: such as fluid-structure interaction, rheology, complex geometries and the pulsatile drive imparted by the human heart. Recent works have improved our understanding on the effects the pulsatile driving has on the flow transition and turbulence in the case of a straight pipe [2]. Now we want to study the combined effects of pulsatile driving and curved geometries.



Turbulent fronts at different Reynolds numbers and geometries from [3]

In this thesis, you will study turbulence transition in pulsatile pipe flow caused by a mildly bent pipe section clamped between two parallel straight sections. You will define geometries with increasing curvature and will perform direct numerical simulations using state of the spectral-element code nek500. You will compare your results to laboratory experiments performed at our institute with the same geometries. The main goal is to determine how turbulence transition depends on the curvature and length of the bent section.

Requirements:

- Basic knowledge in numerical methods for PDEs and fluid mechanics
- High motivation on advanced numerical methods and flow simulations
- Knowledge of hydrodynamic stability is an advantage

Contact and supervision:

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[1] Golledge J, Norman PE. *Arterioscler Thromb Vasc Biol*. 2010; 30(6):1075-1077.
[2] Morón D, Feldmann D, Avila M. *Journal of Fluid Mechanics*. 2022; 948:A20.
[3] Rinaldi E, Canton J, Schlatter P. *Journal of Fluid Mechanics*. 2019; 866:487-502.