Institute of Fluid Mechanics
and Environmental Physics
in Civil Engineering

Master thesis - Numerical modeling of laminar flow in microchannels

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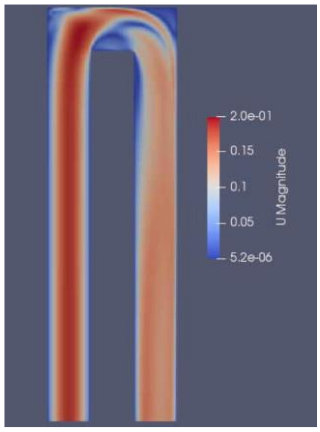

Figure 1: velocity profile at the middle of the channel.

Description

Flow in microchannels plays a crucial role in various applications, including electrolysis. In electrolysis, the design of flow-field channels significantly affects gas bubble transport and, consequently, system efficiency (Wong, 2023). These channels are typically arranged in serpentine or parallel structures, often featuring sharp bends.

This study aims to investigate the velocity profiles and pressure drops across different channel geometries, focusing exclusively on laminar flow. The study may also be extended to explore how variations in bend designs affect overall performance. Additionally, the study will analyse flow detachment and the resulting pressure fields. Simulations will be conducted using OpenFOAM software, and the results will be compared with results from the literature. The model will ultimately be used to identify optimal design parameters for flow-field channels in electrolysis systems.

Objective

3D simulations of water flow in microchannels with different designs, analyzing both the pressure drop and velocity profiles.

Main tasks

1. Literature review.
2. A Hands-on Introduction to Engineering Simulations using open source CFD software (OpenFOAM).
3. Setup of the cases.
4. Convergence analysis and study the effect of local refinement near the walls on the final results.
5. Numerical simulation for different channels designs.
6. Analysis and interpretation of the results.

7. Comparison with the experiential and numerical results from literature.
8. Writing of the thesis.

Requirements

- Background knowledge - Numerical methods in fluid mechanics.
- Basic programming knowledge.
- Motivation and ability to work independently.
- English is the working language for this work.

Contact Information

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References:

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3) Al-Neama, A. F., Kapur, N., Summers, J., & Thompson, H. M. (2017). An experimental and numerical investigation of the use of liquid flow in serpentine microchannels for microelectronics cooling. Applied Thermal Engineering, 116, 709-723.
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