

Cerebrospinal Fluid (CSF) Flow Dynamics

Project Description: Cerebrospinal fluid system plays a critical role in (1) cushioning the brain within its solid vault, (2) formation, flow, and absorption of CSF, and (3) brain metabolism. Yet, there remains a knowledge gap in the regard of CSF flow mechanism and its response to head motions. For instance, the established theory on bulk CSF circulation cannot explain the observations on the basic CSF physiology and mechanism behind the hydrocephalus development. The main goal of this numerical study of the CSF dynamics is to relate CSF flow to head motions as well as different physiological conditions, and to develop effective prevention and intervention strategies for traumatic brain injury.

Job Description: We are seeking a skilled and motivated candidate interested in applying computational fluid dynamics (CFD) to biomedical engineering research and exploring how the convective mixing of CSF flow and flow disturbance grow and decay. Therefore, familiarity with numerical methods is expected. The ideal candidate will have a background in thermal-fluids and experience in fluid-structure interaction. Many efforts will be made to tune the simulation set-up and post-process simulation results. The candidate also should have a can-do attitude and the willingness to explore new things, *e.g.*, image processing for CSF tracking. As another example, the 2nd year of this project would involve acceleration of the numerical simulation by using simulation results to train a deep learning network and incorporating physics-informed neural network into flow prediction.

Basic Qualifications of the Candidate:

- Master's or Bachelor's degree in Mechanical or Biomedical Engineering, Math, Statistics, or a related field with a focus on machine learning.
- Familiarity with a programming language (MATLAB, C or Python).
- Proficiency with a commercially available CFD software package (ANSYS-Fluent, STAR-CCM+, or Open-FOAM).
- Experience in literature review, report drafting, and preparation of journal manuscripts.

This position is funded through Focused Research Extended Experience (FREE) scholarship at our Institute. We believe that this experience and the resulting publication(s) will help the candidate hone research skills and enhance his/her chance in obtaining offers from reputable graduate programs or industry. This position is available immediately.