

脑脊液产生机理和动力学研究

【项目描述】: 脑脊液系统有着缓冲大脑所受重击、流动并吸收脑脊液、以及大脑新陈代谢等三重作用。当前，脑脊液的产生机理以及其对脑部运动的响应仍有待研究。比如，经典的脑脊液循环理论不能解释人体不同姿态下脑脊液的流动特征以及脑积水病理。本课题着眼于脑脊液的数值研究，其主要目标为探寻脑脊液流体动力学与头部运动以及生理情况之间的关联，研究出预防和干预脑部创伤的有效方案。

【职位概述】: 我们正在寻求一位基础扎实、主观能动性较强、对将计算流体力学运用在生物医学工程感兴趣的科研助理。因此，理想的候选人应具有良好的数值方法功底、流体仿真和流固耦合理论方面的相关背景。科研助理将花费大量精力在调试仿真参数以及后处理，研究脑脊液在不同脑室中的混合和干扰如何发展。最后，候选人应具有积极学习新事物和挑战自我的能力，比如学习图像处理以跟踪脑脊液流动。本项目的第二年会涉及训练神经网络，从而将基于物理的神经网络引入数值方法的加速中去。

【职位要求】:

- 机械工程（热流方向）、生物医学工程等相关专业的学士及以上学历，或数学（理想是机器学习方向）、统计学（理想是数据驱动的机器学习方向）等相关背景。
- 熟练研发中的常用编程工具（如 MATLAB、Python、或 C）。
- 熟悉至少一种商用计算流体力学软件（如 ANSYS-Fluent、STAR-CCM+，或 Open-FOAM）。
- 有准备科研报告和学术期刊论文的经验。

得益于本学院的聚焦性科研延展（FREE）项目，候选人将有机会获取开展科研工作所需的专业技能和实操技能，从而增加申请博士或硕士研究生项目获批的可能性以及获得工业届长期工作的机会。该职位拟于 2024 年春季学期或之后开始。有关此项目的问题，请联系徐进博士，电子邮件：jin.xu@scupi.cn。

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, with a negotiable start date no later than May 2024. For questions regarding this position, please contact Dr. Jin Xu, at jin.xu@scupi.cn.