Faculty: Marc Hodes, Professor, Mechanical Engineering, School of Engineering

Project Locations: London (Imperial College London) and/or Oxford (University of Oxford) UK for 3 weeks and 7 weeks Tufts University/Medford in summer 2022.

Dates: June 1 through August 10, 2022.

Project Title: Mathematical Modeling of Biomimetic Lotus-Leaf Type Surfaces

Project Details: Professor Marc Hodes in the Department of Mechanical Engineering has a long-standing collaboration with Professors Demetrios Papageorgiou and Darren Crowdy in the Math Department of Imperial College London and Dr. Toby Kirk in the Math Department of Oxford University. Our project is termed the Red Lotus Project, as it is aimed at exploiting the lubricating properties of the Lotus leaf when used as a platform for surfaces. We have synthesized such biomimetic surfaces in the past and our interests generally involve heat transfer. For example, we have a series of publications related to how such surfaces can be used to enhance the thermal management of electronics by lubricating the flow of liquid metals through microchannels etched into microprocessor chips. Our work has been funded, by, e.g., the National Science Foundation in the US and the Engineering Physical Sciences Research Council in the UK. Modeling the coupled fluid mechanics and heat transfer relevant to such problems is a rich academic opportunity with myriad applications beyond thermal management of electronics. We have exchanged many students between Imperial College London and Tufts University in the past. In such a GRAP program we would do so again and recent applications of our research are related to chromocapillary-stress-driven flows and scavenging of CO_2 from the atmosphere.

Tasks and Responsibilities of Research Assistant:
We have a number of mathematical models in place for the flows of interests in the above-mentioned applications. The student would be responsible for collaborating with us to further advance these models. We would assign well-defined mathematical problems to the student and mentor them closely. We would regularly have meetings over Zoom for the 7 weeks that the student is at Tufts. When the student is in the UK for 3 weeks the meetings would be in person, assuming Professor Hodes can be in residence at the same time. The student would be assigned a problem that they could take ownership up and extends beyond what we have done previously. Thus the student, in the long term, could aspire towards a journal publication in collaboration with us. Tufts (as do Imperial and Oxford) has all necessary licenses to relevant software (Matlab, Mathematica, ANSYS FLUENT, etc.) in place and the student would learn to use some of these software programs. N.b. the on-site presence of the student at Tufts and in the UK assumes that it will not be prevented by Covid-19 protocols.

Qualifications:
The student must have taken all relevant undergraduate math classes and fluid mechanics and heat transfer. Graduate-level math classes, which many undergraduates take as well, would also be very relevant.

Housing in London: The research assistant would live in a temporary apartment at [Vincent House](#) in Notting Hill (or equivalent in Oxford), within walking distance of Imperial College. Vincent House provides lunch and dinner and has laundry machines in the basement. The rooms at Vincent House are singles.