Plans for Future Study

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For the future, I have identified the following several interesting problems to investigate. I have chosen these problems for several reasons, including the potential for very interesting and sophisticated mathematical theory and the scope for applications in different disciplines. I have described some of these problems below in more detail which are of short-term and long-term interest.

1. **Rayleigh-Bernard type problems for Newtonian and Non-Newtonian Fluids in Channels**. Along with collaborators at the University of Pittsburgh and Carnegie Mellon University, I am currently investigating certain problems concerning the flow of Newtonian and Non-Newtonian Fluids in channels with temperature-dependent viscosities. We are particularly interested in issues such as numerical analysis of flow-profiles and the nonlinear stability of certain steady flows.

2. **Existence of Steady Sedimentation of Bodies in a Second Order Fluid**. A second problem that I am currently investigating emerges from my doctoral study. It concerns the existence of steady motions of rigid bodies falling in a Second order fluid at zero *Reynolds Number*. The governing equations consist of a coupled system of nonlinear partial different equations, one of which describes the motion of the fluid and the other, the motion of the sedimenting body. In my thesis, I considered a similar problem, but with the motion of the body prescribed. Our strategy for the more general problem involves the use of a suitable fixed point theorem for multivalued maps, to establish existence of the combined motion. A natural extension of this problem would be to consider the existence problem for the Second order and other Non-Newtonian models with non-zero *Reynolds Numbers* which I would like to study in the future.

3. **Existence of Pulsatile Flows of Newtonian and Non-Newtonian Liquids in Curved Pipes**. Besides my mathematical interest in this subject, this problem is of great significance in biological and industrial applications. The eventual goal of this project is to address questions such as existence of pulsatile flows of Newtonian and non-Newtonian liquids in curved pipes, estimation of the entry-length and pulsatile flows in curved elastic tubes. There are several interesting theoretical and numerical problems that can be addressed here and I have therefore identified this as my main long term project to which I would like to devote the next several years of my research career. Furthermore, I see much scope for collaborations with experimentalists and numerical analysts in this study.

4. **Other Problems**. There are other fields I would like to turn my attention to, over time, as well such as bio-fluid dynamics, turbulence theory, bifurcation theory in fluid dynamics and also astrophysical and geophysical fluid dynamics. In addition, I am open to working and exploring projects where deep mathematical tools can be effectively applied to elaborate on the underlying physics.

The problems that I have addressed so far are driven directly from applications and my approach has always been to understand the problems from different perspectives. This leaves a lot of room for collaborations, with experimentalists, numerical analysts and other experts in the specific areas. Besides working on esthetically appealing problems, I am also interested in working on problems of immediate concern in our society. I see that several of the problems mentioned above have a very good chance of being funded through NSF and NIH grants due to their immediate applicability in industrial and biological issues.