Math 451H – Spring 2019

Stability of converging and diverging thin film flows

Literature:

- 1. D.J. Acheson, Elementary Fluid Dynamics, Oxford Applied Mathematics and Computing Science Series, 1990, ISBN-13: 978-0198596790 (available in the library or from the instructor);
- Selected research articles.

Theoretical Component

- Review of Navier-Stokes equations in viscous regime and simplifications for thin film flow;
- Dimensional analysis & identification of small parameters;
- Consistent asymptotic expansion and reduction of complexity;
- Review of linear stability analysis for gravity driven flow down an incline;
- Formulation of the thin film problem appropriate to the flow in angular geometries;
- Linear stability analysis for the flows with time-dependent base state;
- Comparison of the results of linear stability analysis to experimental and computational results.

Computational Component

- Methods for solving highly nonlinear partial differential equations;
- Review of finite difference methods;
- Introduction to spectral methods for solving partial differential equations;
- Numerical solution of boundary value problems resulting from linear stability analysis;
- Obtaining numerical predictions for instability development in converging and diverging flows.

Experimental Component

- Setting up careful experiments of thin film flows in converging and diverging geometries;
- Developing of appropriate visualization techniques;
- Extracting relevant non - dimensional parameters and comparison with computational and theoretical results.