Hydrodynamic Stability: Theory, Computation and Applications

Overview

Hydrodynamic stability plays a very important role in many industrial and environmental processes as well as in transition to turbulence which has bearing for many practical fields, such as enhanced oil recovery, CO2 sequestration, spreading of contaminant, chemical separation to name a few. This subject at a very basic level is about the effect of infinitesimal disturbances on an otherwise well behaved smooth event or equivalently smooth flow. Whether the effect of such disturbances is going to grow or decay depends on the various parameters of the associated problem including initial data. At times large effects of small disturbance may be desirable such as in mixing between fluid phases and various species in order to enhance chemical reaction. There are situations when it may not be desirable such as in secondary oil recovery where fingering instability is known to be detrimental to oil recovery. Thus there is a need for controlling the growth of instabilities depending on the overall objective of an industrial process whose performance depends on the dynamics of these instabilities. This course will introduce systematically the theory of hydrodynamic stability, which will allow quantification of these growth rates for various flows. These mathematical results can then be used to select appropriate system level controls for improving performance of the system.

A course on hydrodynamic stability builds on solid underpinnings of basic knowledge of fluid dynamics and a variety of tools of applied mathematics all of which will be introduced as often as necessary as the course progresses so that the course is self-contained. The course lectures will be designed with a broad audience from mathematics, physics and engineering disciplines in mind. The examples presented and exercises for the course participants will be tailored to complement the theory taught. Computational tools will be used to exemplify many aspects of this subject. This course will introduce participants current state of the art and will also help students develop an interest in this beautiful subject and perhaps do research in this area.

Objective

The primary objectives of the course are as follows.
(i) Exemplifying in-depth the significance of hydrodynamic stability; with basic mathematical underpinning such as bifurcation theory, eigenvalue problems and normal mode analysis.
(ii) Formulating many practical problems of industrial and environmental interests within appropriate mathematical frameworks for suitable mathematical analysis.
(iii) Providing insights as well as mathematical formulas in some cases for harnessing the results of the lectures to improve system level performance such as enhancing oil recovery.
(iv) Exemplifying many faces of turbulence and transition to turbulence.

Modules	**December 11 – 15, 2017:** **Introduction, Instability in incompressible potential flows, Miscible and immiscible porous media flows, Thermal instability, Transition to turbulence, Applications** **Number of participants for the course will be limited to fifty.**
You Should Attend If…	• Students at all levels (BTech/MSc/MTech/PhD) or Faculty from reputed academic institutions • Engineers and researchers from R&D laboratories.
Fees	The participation fees for taking the course is as follows: **Student Participants: Rs.2000** **Faculty Participants: Rs.6000** **Government Research Organization Participants : Rs.10000** **Industry Participants: Rs.20000** The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. The participants will be provided with accommodation on payment basis.

The Faculty

Prof. Prabir Daripa is in the faculty of Texas A& M University, College Station, Texas, USA. He received his B.Tech. in Mechanical Engineering at IIT Kharagpur in 1978 and subsequently got his graduate education at Brown University, USA and received his M.S. in Engineering in 1982, M.S. in Applied Mathematics n 1983 and Ph.D. in Fluid Mechanics in 1985. He held a post-doctoral position at Courant Institute in New York University. He joined the Mathematics Department at Texas A&M University in 1987. He is a member of editorial boards of nineteen journals including Advances in Mathematical Physics and International Journal of Mathematics and Mathematical Sciences. His primary areas of current research are Fluid Mechanics and Computational Mathematics. He has over 110 journal publications and given well over 160 talks in many countries of which over 85 are invited and plenary talks.

Dr. Manoranjan Mishra is an Associate Professor of Indian Institute of Technology, Ropar. He has obtained his doctoral degree from Indian Institute of Science (IISc), Bangalore in 2004. He held a postdoctoral position at Institut Non Linéaire de Nice, University of Nice Sophia Antipolis, France in 2005-2006, and also at Université Libre de Bruxelles, Brussels (2006-2007). He has been a recipient of Humboldt fellowship of Alexander von Humboldt Foundation (AvH), Germany during 2007-2008 and FRS-FNRS fellowship from Fonds de la Recherche Scientifique, Belgium in 2008-2009. He received the JSPS invitation fellowship in 2015. He has over 35 journal publications and over 50 conference presentations at various international conferences of which over 10 are invited talks. His primary research interest is in Fluid mechanics.

Course Co-ordinator

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