Stability of Vortices and Non-isothermal Parallel Flow

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Overview

Vortices are ubiquitous in flows encountered in various natural phenomena and a number of engineering applications. Understanding the dynamics of vortices is indispensable for predicting the phenomena and controlling and/or optimizing the devices. Stability is one of the most fundamental dynamical aspects of the vortices. Although stability analysis in fluid dynamics has long history, our knowledge of stability of vortices are still increasing; unknown mechanisms of instability have been revealed and new methods and concepts have been introduced. Among them, the elliptic instability and the curvature instability are now recognized as important concepts in vortex dynamics. Since the elliptic instability arises when (quasi-)steady flow possesses elliptic streamlines; it appears in strained vortices which are observed in geophysical and astrophysical fluids. The curvature instability arises when vortex tubes are curved; it appears in vortex rings and helical vortices, which are formed in flows around helicopters, wind turbines and turbomachinery.

Apart from these, while studying non-isothermal flow in ducts, using parallel flow hypothesis, vortex evolves in perturbed flow. The instability of this vortex, which is a consequence of mixing of fluid layers, leads to turbulence in the end. This can be understood through stability analysis, especially non-linear analysis.
Sophisticated knowledge of applied mathematics are required to understand the flow mechanism of non-isothermal parallel flow as well as elliptic and curvature instabilities, while useful tools have been developed to analyze them: perturbation expansion, local stability analysis, finite amplitude analysis, Hamiltonian fluid mechanics, energy principle, etc. These knowledge and tools should help us study problems of fluid dynamics.

Course duration	**4th December 2017 to 9th December 2017** **Number of participants for the course will be limited to fifty.**
You Should Attend If…	▪ you are an applied mathematician or researcher interested in flow transition in wall bounded domain or free boundary domain. ▪ you are a mechanical/chemical/civil engineer or research scientist interested in flow transition in wall bounded domain or free boundary domain, or you may be required to know this concept as a prerequisite for your theoretical or experimental studies on turbulence. ▪ you are an atmospheric scientist or physicist interested in stability of strained vortices, you are from oceanography or you are a geophysicist interested to how to study the stability of the flow in wall bounded domain or in free boundary domain in your profession. ▪ you are a student or faculty from academic institution interested in learning how does flow transition takes place in wall bounded domain as well as free boundary domain .
Fees	The participation fees for taking the course is as follows: **Participants from abroad : US $ 500** **Industry/ Research Organizations within India: ` Rs. 15000** **Faculty/staff from Academic Institutions within India: Rs. 5000** **Sudents From India:** **Ph.D/Post doctoral Rs. 2000/3000** **M.Tech/M.Sc Rs. 1000** The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. Boarding, lodging and meal charges are not included in the fees. The participants will be provided with accommodation on payment basis.

The Faculty

Prof. Yuji Hattori is Professor, Institute of Fluid Science, Tohoku University, Japan. His research interests includes Fluid Dynamics, Numerical Analysis and Applied Mathematics. He is a recipient of Ryumon Prize, Japan Society of Fluid Mechanics. His, current active areas of interest are Modal and nonmodal stability analysis of helical vortex tube, turbulence, evolution of lacalized disturbances in the elliptic instability, explosive magnetic reconnection caused by an X-shaped current-vortex layer in a collisionless plasma, etc.

Dr. Premananda Bera is an Associate Professor of Indian Institute of Technology, Roorkee. His research interest includes: stability of duct-flow, Taylor-Couette flow, convection in porous media, Computational fluid dynamics using Spectral/spectral element/finite difference methods.

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Course Co-ordinator

Prof. Premananda Bera
Associate Professor
Department of Mathematics
IIT Roorkee-247667, India
Phone: 01332-285071
E-mail: pberafma@iitr.ac.in

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