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Variational principles for topological non-barotropic fluid dynamics

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I deal barotropic fluid flows with the same circulation structure as steady flows generically have commoving physical surfaces on which the vortex lines lie. These become Bernoullian surfaces when the flow is steady. When these surfaces are nested (vortex line foliation) with the topology of cylinders, toroids or a combination of both, a Clebsch representation of the flow velocity can be introduced. This is then used to reduce the number of functions to be varied in the variational principles for such flows. We then can introduce a three function variational formalism for steady and non-steady barotropic flows. In ideal non barotropic flow, circulation is not conserved in the general case but one has a new commoving variable, that is the entropy itself. We will show how entropy considerations will affect the construction of compact variational principles and what are the unique topological local and global conservation laws associated with non-barotropic flows which are derived from those variational principles. The results are compared with analogous study of variational principles and topological constants of motion in non-barotropic magnetohydrodynamics. Possible applications such as flow stability analysis and numerical simulations will also be mentioned.

Biography

Asher Yahalom is a Full Professor in the Faculty of Engineering at Ariel University and the academic Director of the Free Electron Laser User Center which is located within the University Center campus. He received his BSc, MSc and PhD degrees in Mathematics and Physics from the Hebrew University in Jerusalem, Israel in 1990, 1991 and 1996 respectively. He was a Postdoctoral Fellow (1998) in the Department of Electrical Engineering of Tel-Aviv University, Israel. He was a Visiting Fellow at the University of Cambridge, UK during the years 2005-2006, 2008 and 2012.

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