PREFACE: VISUALIZATION OF COMPLEX FLOW STRUCTURES IN JETS AND WAKES

Jets and bluff-body wakes are flow phenomena seen in several important applications. Accompanying flow fields determine the performance of engineering equipment, along with rates of energy and species transport in nature. Flow distribution in jets and wakes of bluff objects are quite complex and are known to carry well-defined vortex structures. These structures provide an understanding of various instability mechanisms and transitions experienced by a simple jet of water from a tap to the complex exhaust of gas turbines. With the development of high-speed imaging systems and efficient computational fluid dynamics simulation tools, it is now possible to record details of flow structures and their evolution in diverse contexts. New generation visualization algorithms vividly represent experimental as well as numerical data. The applicable flow physics underlying complex flow structures emerge naturally from such analysis, contributing to a fundamental understanding of the subject.

This special issue contains studies on jets and wakes carried out using experiments and computations (in two- and three-dimensions) dealing with many exciting flow phenomena. Out of the ten papers selected, two articles are concerned with distinct aspects of a high Mach number jet, the third is about a cushioned planar jet, while the remaining articles describe vortex interactions in the wake of flow over an obstacle.

Although two of the three studies on jets are experimental, the investigation by Mohd et al. uses computations along with the particle image velocimetry (PIV) technique to characterize the primary vortex rings and embedded shock in a compressible jet at a Mach number of 1.5. Kriparaj et al. used schlieren imaging to characterize under-expanded compressible jets emerging from corrugated lobed nozzles at a Mach number of 1.71. The investigation by Bodhanwalla et al. is a numerical study of the stability of a falling liquid curtain in the form of a compressible air-cushioned two-dimensional jet.

Out of the seven articles on wakes, six investigations are based on computations and are mostly concerned with low and intermediate Reynolds numbers. Two investigations on wakes focus on the control of vortex shedding: Mishra and De report three-dimensional turbulent flow computations to determine the aerodynamic properties of flow past an aerofoil with its leading-edge tubercled as a passive control technique. Similarly, the vortex-induced vibration (VIV) investigation by Mittal and Sharma employs a detached splitter plate, rigid or flexible, as a passive element to suppress vortex shedding past a circular cylinder. The third article (by Paul et al.) employs reduced-order modeling using proper orthogonal decomposition of flow past a rectangular cylinder. The fourth article (by Jang et al.) reveals the effect of incoming oscillatory flow on a wall-mounted cylinder in the context of off-shore structures. Jang et al. adopt a high-fidelity three-dimensional direct numerical simulation method to compute flow at a relatively low Reynolds number. Two additional articles discuss VIV of a rigid body by modeling it as a spring-mass-damper system. Two-dimensional simulations of VIV flow and heat transfer past obstacles are reported by Biswal et al. to unearth the effect of various

mass ratios and reduced velocity on heat transfer from the cylinder. Similarly, Sharma et al. reveal the nuances of VIV flow characteristics at various Reynolds numbers and reduced-order frequencies for a fixed mass ratio and damping ratio. The seventh article about wakes (by Patel et al.) characterizes granular flow past obstacles having various shapes using the shadowgraph technique and a limited number of PIV experiments that compare the shock profile of granular flow with high Mach number gas flow past an obstacle.

The range of subjects covered in the special issue is considerable and should inspire newer authors to pursue the subject domain. Accordingly, the editors of the special issue cordially invite prospective authors to publish their original and substantive research in the Journal of Flow Visualization and Image Processing.

Guest Editors:

Arun K. Saha and K. Muralidhar
IIT Kanpur, India