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EDITORIAL

Preface: special issue on the hydrodynamic and fluvial instabilities

Subhasish Dey[1]

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1 General

In the nineteenth century, *hydrodynamic stability* was recognized, notably by Helmholtz, Kelvin, Rayleigh on inviscid flows and Reynolds on viscous shear flows, as one of the core problems of fluid mechanics. The remarkable description by Reynolds of his classic series of experiments on the instability of flow through a tube was concerned about when and how laminar flows break down, their subsequent evolution and eventual transition to turbulence. The seminal work of Orr and Sommerfield in the 1950s to derive the classical linear stability equations stimulated a new era for the study of the transition to turbulence in viscous flows. Since then, researchers have been investigating the flow instability and the findings have been used to engineering, meteorology, oceanography, and geophysics. Besides, in natural phenomena, the variations in viscosity and density in space and time can have a substantial effect and can lead to unusual behavior.

In addition, *fluvial instabilities* originate from an interplay between the carrier fluid and the erodible loose boundary at their interface, manifesting a variety of sedimentary architectures with length scales spanning from a few millimeters to hundreds of meters. Streambed patterns are grouped into three major classes in terms of their characteristic streamwise wavelength, such as small-scale, intermediate-scale, and large-scale patterns. The small-scale patterns (characteristic wavelength is of the order of the flow depth) include ripples, dunes, and antidunes. The intermediate-scale patterns (characteristic wavelength scales is of the order of the channel width) comprise bars. In addition, the large-scale patterns (characteristic wavelength is of the order of the landscape width) include meandering streams. In a fluvial environment, two major sedimentary architectures prevail. The first kind corresponds to the evolutions of streambed with streamwise and spanwise directions, leading to the formation of bedforms (e.g., ripples, dunes, and antidunes) and bars, respectively. On the other hand, the second kind is related to the channel course over the landscape (e.g., a meandering channel). These sedimentary architectures are manifested owing to instabilities of the fluid-bed interface.

This Special Issue of the Environmental Fluid Mechanics titled *Hydrodynamic and Fluvial Instabilities* has aimed to collect recent theoretical, numerical, and experimental

✉ Subhasish Dey
sdey@iitkgp.ac.in

[1] Department of Civil Engineering, Indian Institute of Technology Kharagpur, Kharagpur, West Bengal 721302, India

developments in this research field. Although the preference has been given to the fundamental issues, papers focusing on important unconventional or emerging applications of broad interest and state-of-the-art review are also included.

2 Special issue contents

The Special Issue includes seventeen papers, which can be classified into three categories. The first category is comprised of the papers belonging to the hydrodynamic instabilities by Sahu [1] on two-layer fluid flow, Castro-Orgaz and Chanson [2] on undular hydraulic jumps, Pang and Ó'Náraigh [3] on contact-line motion in lubrication theory, Hassanzadeh et al. [4] on buoyant miscible jet flows, Matar et al. [5] on three-dimensional falling liquid films, Maggi et al. [6] on gravity currents propagating over roughness elements, and Taborda et al. [7] on wave-like motion and secondary currents in arrays of emergent cylinders. The second category includes the papers on the fluvial instabilities by Dey et al. [8] on sand waves sheared by turbulent flow, Huang et al. [9] on impact of bedform migration on nutrient fluxes, Sahagian et al. [10] on unifying criterion for meandering systems, Chevalier and Larrarte [11] on flow instability close to a scour affected abutment, Colombini [12] on instabilities in shallow-water river flows, and Ragno et al. [13] on idealized tide-influenced delta network. Four papers on the instabilities in vegetated channels fall into the third category. These papers are by Branß et al. [14] on effects of bedforms and vegetation strips on levees in compound channels, Caroppi and Järvelä [15] on shear layer over floodplain vegetation, Penna et al. [16] on bed morphology in vegetated channels, and Carbonari et al. [17] on multiple patches of aquatic vegetation.

The Guest Editor finally hopes that this Special Issue would be beneficial to advance future research studies and to further develop the instability concepts, including related issues in experimental models.

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