Recent Mathematical Advances Regarding Industrial Problems in Fluid Mechanics

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Despite major advancements in mathematical analysis and numerical approximation for computational fluid dynamics, many industrial applications remain challenging to simulate. These range from simulating nonNewtonian fluids at low Reynolds numbers to simulating Newtonian fluids at large Reynolds numbers. For examples of the former we mention food processing, design of motor oils, and modeling bodily fluids, although there are also many more. As an example of the latter we mention flow around transportation vehicles, race cars, and buildings. But also internal flows are equally of interest in biomedical applications, ventilation systems, and so on.

Fortunately, advances are still being made related to understanding and simulating different types of fluid flows. From our own work, these relate to nonNewtonian fluid models having a transport equation for the stress [1] and Reynolds–Orr instability analysis for flow past a bluff body [2]. Many more examples will be explored in the minisymposium, such a the role of unstable blood flow perturbations in aneurysms.

We propose to organize a session at M2P 2023 to highlight these mathematical advances and present their applications to industrial problems. In this minisymposium we focus on advancements in the mathematical understanding of, and computational methods for, fluid dynamics. We will solicit and welcome talks related to e.g.

- nonNewtonian flow models and their mathematical analysis,
- mathematical analysis of high Reynolds-number flows and turbulence,
- discretization methods related to both high Reynolds-number Newtonian flow and nonNewtonian flow,

and not least their applications in simulating biomedical, industrial or aerodynamic fluid flow.

References

[1] I. G. Gjerde and L. R. Scott, *Kinetic-energy instability of flows with slip boundary conditions*, Journal of Mathematical Fluid Dynamics, 24 (2022), p. 97.

[2] S. Pollock and L. R. Scott, *An algorithm for the grade-two rheological model*, M2AN, 56 (2022), pp. 1007–1025.

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