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Preface to the sixth special issue on "Practical Asymptotics"

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In many fields of research, direct numerical simulation (DNS) is the preferred technique to solve the complex equations arising from real-world problems. Modern computers have the ability to solve large systems of equations as well as to deal with complex geometries. Indeed, it is not uncommon for researchers to claim that approximate analytical approaches have now been superseded by DNS. In the future, with further increases in computational power, these claims will undoubtedly become more frequent. It is the role of this series of *Special Issues on Practical Asymptotics* [1–5] to dispel this myth.

Computational studies should be guided by a theoretical framework in order to gain more comprehensive insight. The most important contribution of asymptotics is to provide this theoretical framework for understanding, interpreting, developing and solving mathematical models. Practical problems usually involve a number of parameters and coordinates so that the full numerical solution offered by DNS conceals the different balances holding over limited ranges of these parameters and coordinates. Singular perturbation theory is the systematic and reliable approach to revealing regions of qualitatively different behaviour. Furthermore, a researcher employing asymptotic methods would be rewarded with explicit parameter dependencies and simplified governing equations.

It is noteworthy that asymptotic approaches are cheaper to implement than computational techniques. The cost of computational studies may prohibit numerical simulations at a number of parameter values which limits, for example, the optimization of prototypes. There still exists a number of practical problems which are tractable for approximate analytical methods but inaccessible to computation.

The special issue invites research articles addressing the following problems: drag coefficients in low Reynolds number flow [6], ice formation on a cold surface due to the impact of a supercooled water droplet [7], droplet impacts with a porous medium [8], the propagation of fronts in a discrete reaction–diffusion equation [9], fluid–solid interactions [10] and geothermal heat exchangers [11]. The analyses comprise a range of perturbation methods, including a hybrid asymptotic-numerical method, matched asymptotic expansion and WKBJ methods, all of which demonstrate the importance of asymptotics in real-world applications.

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