Introduction to Practical Asymptotics III

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This issue of the *Journal of Engineering Mathematics* is the third in a series on the theme of *Practical Asymptotics* [1, 2]. Asymptotic techniques occupy a special place in applied mathematics, serving as a bridge between complex models of physical systems and the fundamental mathematical problems buried within them.

Predicting the behavior of many problems of practical interest is often difficult because of the presence of many competing effects which can influence the outcome. Mathematical modeling is the process of identifying the hierarchy of more and less important effects in problems. Neglecting the less important effects can yield simpler problems which are more mathematically tractable and yield qualitative insight and good quantitative estimates for the behavior in the original problems. The basis for perturbation methods is not to neglect these small effects altogether, but asymptotically, such that richness of models is not sacrificed to tractability and vice versa. This can be no easy feat for problems where effects are intricately intertwined or effects are not uniformly small. To correctly predict some properties of singular problems, the influence of weak effects may still be crucial. Perturbation methods and asymptotic analysis can offer ways to systematically study problems that may otherwise be inaccessible. Using well-chosen asymptotics, advances can be made on understanding systems whose direct solutions might be prohibitively slow, even on today's fastest computers.

As part of the introduction to this issue, we wish to pay respect to the memories of several leading applied mathematicians in appreciation for the important contributions they have made to asymptotics, in the development of analysis and general techniques and in research connected to specific application areas in the applied sciences: G. F. Carrier (1918–2002), J. D. Cole (1925–1999), D. Crighton (1942–2000), W. Eckhaus (1930–2000), A. C. King (1957–2005), M. J. Lighthill (1924–1998), and J. L. Lions (1928–2001). Lighthill and Lions were members of the honorary advisory board for this journal and King served on the board of associate referees.

The articles contained in this special issue illustrate the diverse set of problems where asymptotics are applicable. The topics covered span mechanics, materials science, biological systems, fluid dynamics, waves, and oscillations. Additionally, this issue includes the seventh in the Journal's series of *James Lighthill Memorial Papers*, this year's being written by S. Howison on the use of asymptotics to study problems in finance.

References

1. H.K. Kuiken (ed.), *Practical Asymptotics*. Dordrecht: Kluwer Academic Publishers (2001) iv+385 pp. Reprint of *J. Engng. Math*. 39 (1–4) (2001) 1–385.
2. M.H. Holmes and J.R. King (eds.), Practical Asymptotics II. *J. Engng. Math.* 45 (3–4) (2003) 155–404.