# COST-EFFECTIVE APPROACHES TO PREDICTIONS OF THERMOFLUID PHENOMENA IN ENGINEERING SYSTEMS

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**ABSTRACT** Cost-effective approaches to numerical predictions of thermofluid phenomena in engineering systems facilitate the elucidation of the underlying physics of these phenomena and the optimal designs of such systems. The term 'cost-effective' is used here to categorize approaches that allow predictions of acceptable accuracy and computational times (these are relative terms that require a suitable context for meaningful interpretation, as is elaborated in this presentation). The focus in this presentation is on hybrid approaches with the following key features: multi-dimensional mathematical models are used only in portions of the system where it is critically important to do so; in relatively simpler portions of the system, semi-analytical quasi-one-dimensional or quasi-two-dimensional models are used; and the numerical solutions of these models are iteratively coupled. In unsteady problems, such approaches could involve a combination of fully time-dependent and steady (or quasi-steady) formulations, when justified. Hybrid approaches involving combinations of analytical and numerical methods are not discussed in this presentation (instead, references are made to some related seminal and important contributions of several Brazilian researchers). Cost-effective hybrid approaches to numerical predictions of thermofluid phenomena have appeared in the published literature for over 25 years. In this presentation, excerpts from some recent works on such approaches to predictions of thermofluid phenomena in micro-grooved vapor-chamber heat spreaders, latent-heat (solid-liquid) thermal energy storage in plate-fin enclosures, closed-loop thermosyphons, interrupted-plate ducts, and thermal energy storage in rock beds are discussed.