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Analytical-Computational Methods in Energy Efficiency and Sustainable Energies

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ABSTRACT

Sustainable energies, renewable or not, in general combined, have been shown as an alternative to guarantee the energy transition in matrices strongly based on fossil fuels. On the other hand, the recovery and reuse of rejected heat from electricity generation or secondary processes, and the harvesting of different forms of waste energy usually neglected (energy harvesting), whether from natural or built systems, has received increasing attention in the scientific literature, in the search of greater global energy and exergy efficiencies.

The research at UFRJ and collaborators is recognized for the development of hybrid analytical-numerical methods for partial differential equations (PDEs), with several applications especially in transport phenomena. A mixed differential-concentrated reformulation strategy, known as the Coupled Integral Equations Technique (CIEA), and a hybrid methodology for PDEs by integral transformation, known as the Generalized Integral Transform Technique (GITT), have been developed over more than 35 years to the analytical-computational treatment of problems in linear and non-linear convection-diffusion.

These analytical-computational methodologies are here illustrated in the analysis of applications in sustainable energies and energy efficiency, with substantial gains in precision and computational cost, in particular for intensive computations such as in optimization, inverse problems, and simulation under uncertainty.