Nonsmooth Problems with Applications in Mechanics
Olomouc, Czech Republic, May 19-23, 2025

Discontinuous behavior of the thermal dissipation in a differentially heated cavity with conjugate heat transfer

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Abstract: Conjugate heat transfer is encountered in most real-world applications and has a major impact on the physics of a wide range of industries, including heat exchangers, chemical reactors, solar collectors, and electronics. In Computational Fluid Dynamics (CFD), accurately predicting temperature fluctuations in fluid flow is both challenging and crucial. Indeed, these fluctuations can cause variations in adjacent solid walls, leading to cyclic thermal stresses and potential fatigue cracking.
Several studies have investigated conjugate heat transfer in turbulent forced convection. However, to the best of the author's knowledge, no reference data exist for turbulent natural convection, despite the common occurrence of such flows. This study takes a step toward addressing this gap in the literature.
Thermal dissipation, involving the derivatives of the temperature fluctuations, exhibits a nonsmooth behavior at the fluid-solid interface, posing a major challenge for accurate physical modeling. The present study explores the coupling between flow dynamics and thermal penetration in the solid through high-resolution simulations and advanced numerical methods, aiming to analyze the underlying physics and provide datasets for the modeling community.