

Review of: "Tailoring the First Law of Thermodynamics for Convective Flows"

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Potential competing interests: No potential competing interests to declare.

1. The novelty of this work is partially undermined by the limited exploration of existing theories on nonequilibrium thermodynamics. The introduction glosses over well-established approaches in extended irreversible thermodynamics and stochastic thermodynamics. A more comprehensive comparison with current research could strengthen the paper's case for novelty and applicability, helping the reader understand the gaps this paper fills.
2. The goal to derive a "global energy balance" formula applicable to nonequilibrium convective systems is clear and aims to mirror the familiar form of equilibrium thermodynamics. However, the specific hypotheses or research questions guiding the study are vague. The reader is left uncertain as to whether the paper seeks to prove theoretical consistency, establish practical utility, or predict empirical phenomena. Explicitly stating testable hypotheses or research questions would provide focus, helping to measure the success of the derived equations.
3. The paper relies heavily on assumptions without sufficient justification. For instance:
 1. The assumption that the system is "closed" and that there is "no flow through the surface" limits the generality of the findings, particularly for many practical systems where boundaries permit some interaction with the surroundings.
 2. The choice of slip boundary conditions over no-slip boundaries is not justified, despite this assumption's critical impact on derived equations and overall applicability to real-world systems, where no-slip conditions are more common.
 3. By assuming quasi-steady states for time averages, the study excludes a wide range of turbulent phenomena, which may behave differently under non-steady conditions. Addressing these assumptions or providing justifications would enhance the credibility and robustness of the conclusions