THERMODYNAMIC SELF-IMPROVEMENT IN THE STABILITY OF A LOW DISSIPATIVE REFRIGERATOR ENGINE

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ABSTRACT

The optimization of energy converters using different objective functions has become a relevant issue due to the energetic needs of the everyday most specialized heat devices. The stability of the operation regime of such devices is always addressed as a separate subject. Thus, the link between the robustness of the steady state and the optimization process, as well as the thermodynamic consequences of limited control on the operation regime is still an ongoing topic with phenomena yet to understand [1].

In order to provide a somewhat general view for a class of heat devices, not attached to specific heat transfer mechanism, we make use of the so-called low-dissipation refrigerator engine [2-7].

In this work we analyse random perturbations on a low-dissipation refrigerator engine's operation regime. For the operation regime we use the Omega function, which represent a compromise between cooling power and efficiency. We found that the trajectories to the steady state follow paths in which the most relevant thermodynamic functions are improved. And under continuous perturbations the resulting stochastic trajectories follow a statistical behaviour in which the role of the thermodynamic functions play a most relevant role. The results obtained from this study are reinforced by a multi-objective optimization study of this refrigerator engine, in which it is required a simultaneous optimization of all the relevant thermodynamical quantities, that is, efficiency (coefficient of performance), cooling power, power input, entropy production and the Omega function. We also make use of the Kullback-Leibler divergence to account for statistical convergence in the obtained numerical results.

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