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Title:	Thermodynamic Studies of Thermoelectric Energy Conversion: Design Constraints and Performance
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Abstract:	Abstract Thermoelectricity is a non-equilibrium phenomenon that can be studied within the linear- irreversible framework by Onsager and Callen. Traditionally, thermoelectric phenomena are treated as steady-state processes at the local level, but the actual devices have a finite exten- sion, so their performance needs to be analyzed by scaling up the local description. This study clarifies the presence of nonlinear terms in thermal fluxes, while the equality of the Onsager cross-coefficients is also extended to the global level. Next, an inhomogeneous thermoelectric material has been proposed that enhances the optimal performance of a thermoelectric generator in the presence of internal and external irreversibilities. For a particular linear form of spatially varying lattice thermal conductivity in a material, the heat leakage term drops out while the Joule heat is dumped into one of the two heat reservoirs. In another study, the effective ther- mal flux in an autonomous heat engine has been found where the heat engine is modelled as a linear-irreversible channel. Interestingly, the effective flux is obtained as a certain mean of the hot and cold thermal fluxes, though its exact form depends on the nature of irreversibilities within the model. Further, an endoreversible thermoelectric generator is studied using finite physical dimensions constraints. This analysis is based on the linear-irreversible law for heat transfer between the reservoir and the working medium, in contrast to Newton's law usually assumed in literature. The optimization of power output is performed with respect to the ther- moelectric current and the fractional area of the cross-section of the heat exchangers. This analysis gives more freedom in optimizing the design of a thermoelectric generator.
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