Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Geometry of thermodynamic control DAVID SIVAK, University of California, San Francisco, PATRICK ZULKOWSKI, MICHAEL DEWEESE, University of California, Berkeley, GAVIN CROOKS, Lawrence Berkeley National Laboratory — A fundamental problem in modern thermodynamics is how a molecular-scale machine performs useful work, while operating away from thermal equilibrium without excessive dissipation. We show that when a thermodynamic system is driven from equilibrium, in the linear response regime, the space of controllable parameters has a Riemannian geometry induced by a generalized friction tensor. This metric structure controls the dissipation of finite-time transformations, and bestows optimal protocols (geodesics on the Riemannian manifold) with many useful properties. We exploit this geometric insight to construct closed-form expressions for minimal-dissipation protocols for a model system of a particle diffusing in a one-dimensional harmonic potential, where the spring constant, inverse temperature, and trap location are adjusted simultaneously. This simple model has a surprisingly rich geometry, which we test via a numerical implementation of the Fokker-Planck equation.

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Date submitted: 24 Oct 2012 Electronic form version 1.4