Abstract

The Landauer's Principle states that information erasure will be accompanied by heat dissipation of at least k_b Tln 2 per bit, where k_b is the Boltzmann constant and T is the temperature. The bound is significant, as it establishes a physical limitation on the improvement modern day electronic switches in terms of size and efficiency. Our analysis adds to the handful of existing studies that have demonstrated an experimental and computational validation of Landauer's Bound. Utilizing optical tweezers, we model a one-bit memory as a Brownian particle in a double well potential and propose a novel method to erase it, based on manipulation of the optical traps. We quantify the heat dissipation in erasing the memory by resorting to 'stochastic thermodynamics' framework for Langevin systems developed by Sekimoto. Using extensive Monte Carlo simulations and experiments we demonstrate that the lower bound for average heat dissipation, per erased bit, is achieved thereby validating Landauer's claim. Thus, we present an independent verification of Landauer's principle, further enforcing the fundamental link between Thermodynamics and Information Theory.