GAMBLING CARNOT ENGINE

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ABSTRACT

We propose a theoretical model for a colloidal heat engine driven by a feedback protocol that is able to fully convert the net heat absorbed by the hot bath into extracted work. The feedback protocol, inspired by gambling strategies, executes a sudden quench at zero work cost when the particle position satisfies a specific first-passage condition. As a result, the engine enhances both power and efficiency with respect to a standard Carnot cycle, surpassing Carnot's efficiency at maximum power. Using first-passage and martingale theory, we derive analytical expressions for the power and efficiency far beyond the quasistatic limit and provide scaling arguments for their dependency with the cycle duration. Numerical simulations are in perfect agreement with our theoretical findings, and illustrate the impact of the data acquisition rate on the engine's performance.

Keywords: stochastic thermodynamics, feedback control, first passage times, heat engines

REFERENCES

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