Proceedings of the T2022
International Conference on Thermodynamics 2.0
July 18-20, 2022 | Boone, NC, USA

T2.0:2022-0138

MINIMUM INFORMATION VARIABILITY CONTROL

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ABSTRACT

Feedback control has successfully been exploited since the early 20's for industrial, medical and scientific purposes. Its success relies on both the simplicity of its conceptualization and its implementation. In general, the design of classical control techniques, such as the proportional-integral-derivative (PID) control variants, and modern techniques, like the model predictive control (MPC), depends on the solution of an optimization problem. For instance, the Linear Quadratic Regulator characterized by a cost function that minimizes the error between the dynamics and the desired stated while regularizing the control effort. Most of the current cost functions used for control design demonstrate that the tracking or regulation of the dynamics is a common requirement in the engineering scenarios. However, these cost functions can be meaningless in modern complex systems where the entropy, the information variability or the energy minimization are the set up as central goals.

In this regard, this work explores the application in control design of the concept of information length, an information geometry concept used to describe the total amount of statistical changes that a probability distribution takes through time and whose minimization will thus reduce the disorder in stochastic systems. Information length is presented as a cost function that considers both information and thermodynamic aspects useful for the controllers' design. We design full-state feedback controls for linear stochastic processes, producing small statistical fluctuations and oscillations in the closed-loop time system's response. Effects on the system's entropy production are also analyzed.

Keywords: information geometry, control theory, stochastic thermodynamics

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