

Research



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Systems, variational principles and interconnections in non-equilibrium thermodynamics

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The paper investigates a systematic approach to modelling in non-equilibrium thermodynamics by focusing upon the notion of interconnections, where we propose a novel Lagrangian variational formulation of such interconnected systems by extending the variational principle of Hamilton in mechanics. In particular, we show how a non-equilibrium thermodynamic system can be regarded as an *interconnected system* of primitive physical elements or subsystems throughout an *interconnection*. While this approach is new in non-equilibrium thermodynamics, this idea has been known as a useful tool for the modelling of complicated systems in networks as well as in mechanics. Hence, the setting developed in this paper yields a promising direction for building a unifying description in various areas of modern science via thermodynamic principles, while being at the same time related to the early developments of variational mechanics.

This article is part of the theme issue
'Thermodynamics 2.0: Bridging the natural and
social sciences (Part 2)'.

1. Introduction

(a) Variational principle in thermodynamics

One of the most fundamental principles in physics is the Principle of Critical Action. Maxwell's equations in electromagnetism, Newton's equations of motion in

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