

MAXIMUM ENTROPY PRODUCTION PRINCIPLE AND SELF-ORGANIZATION

Georgi Yordanov Georgiev

Assumption University, Worcester, Massachusetts, USA
Worcester Polytechnic Institute, Worcester, Massachusetts, USA
Tufts University, Medford, Massachusetts, USA

ABSTRACT

Organization is the creation of flow channel structure in systems away from thermodynamic equilibrium to maximize the rate of flow of matter and energy through the system. As a result, it maximizes its entropy production. Flow channels are defined as the paths of least action for matter and energy through the system, where the obstacles for motion have been minimized by work done by the flows to remove them from the paths. Therefore, the amount of physical action for the flow of matter and energy has been minimized, which can be described by increased action efficiency of the flows. This obstructive constraint minimization is a variational principle by itself connected directly to the principle of least action. Creating this internal structure minimizes the internal entropy of the system as the degrees of freedom of its building blocks have been decreased. Therefore, the decrease in internal entropy of the system corresponds to increase of the external entropy production. We can interpret this, that the second law of thermodynamics is the principle for reducing the internal entropy in systems. In this way, it creates higher levels of organization during development and evolution of systems of any nature, being they physical, chemical, biological, engineering, economical or social. Some examples are Rayleigh-Benard convection cells, vortices, vascular networks in plants and animals, flows of energy in ecosystems and infrastructure systems.

Keywords: Maximum Entropy production principle, second law of Thermodynamics, self-organization, principle of least action, evolution, development