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PATHWAYS TO UNITY: ENTROPY PRODUCTION AND THE CONSTRUCTAL LAW

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ABSTRACT

Questions remain regarding the extremum principles which determine the evolution of such systems. Several theorems and principles have been proposed, including that of the maximum entropy production principle and the Constructal law. At times, advocates of these systems have indicated that one principle of the other is either irrelevant, contradictory, or merely a corollary of the other. Here, it is attempted to show in the form of two separate articles that these principles are equivalent to one other. A comparative literature study that underlying both of these ideas are two principles: Firstly, flow networks operate with the ability for the flow channel to vary its conductance (either by transport coefficient or channel geometry modifications). Secondly, the flow network analyzed are branched channels. This latter point is an outgrowth of the former: adding branches increases the conductivity. Indeed, the Constructal law can be viewed mathematically as stating that the flow conductance increases in time for “thriving” systems. This formulation allows for a direct comparison to MEP, which states that the rate at which entropy is produced increases when possible. It is then shown that these expressions are indeed equivalent. In order to do so, it is shown that for isolated systems, an increase of conductivity in any part of the system is equivalent to increasing the entropy production rate for the system as a whole. Finally, the implications of these arguments for other proposed extremum principles (e.g., minimum entropy production) are considered and analyzed.

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Keywords: entropy production, Constructal law, transport conductivity

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