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Thermostatistical study of the opinion formation phenomenon in the DNAW model

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The model proposed by Default, Neau, Amblard, and Weisbuch (DNAW) is relevant in sociophysics for studying the phenomenon of opinion formation in social systems composed of agents that interact in a binary manner. Its relevance lies in the fact that, through the formulation of an opinion exchange rule between pairs of agents whose opinion differences are smaller than a bounded confidence threshold (d), and which is expressed in terms of a convergence parameter (μ), it is possible to reproduce collective phenomena observed in social systems such as consensus, fragmentation, and polarization. Within the framework of this model, by establishing an analogy between a system of social agents and an ideal gas of free particles, we present a novel thermostatistical study of the opinion formation phenomenon based on the definition of the following macroscopic variables: social temperature (Ts), social entropy (Ss), and social chemical potential (Ps). In particular, we define Ts as the first absolute moment of the opinions of all agents in the system with respect to the average opinion (Op) per agent. Through numerical simulations that systematically explore the parameter space (d, μ), we first identify the equilibrium state as the state for which Ss stabilizes and estimate the convergence time as the elapsed time required to reach equilibrium. Subsequently, we study the opinion formation process by analyzing the temporal evolution of the macroscopic variables Op, Ts, Ss, and Ps. In this way, we observe that d can be interpreted as a measure of social tolerance to interact with differing opinions, while μ quantifies the degree of mutual influence between a pair of agents during an interaction.

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