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The role of self-organized criticality in social dynamics

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Recent advances in social sciences are based on extensive data analysis. In this context, theoretical physics concepts such as self-organized criticality are precious to making sense of the available empirical data. Self-organized criticality refers to the properties of driven dynamical systems of many interacting elements under repeated perturbations to reach a stationary state with long-range spatial and temporal correlations resembling the critical fluctuations near the second-order phase transitions. The self-organized critical states appear as the attractors of the nonlinear dynamics, which are characterized by avalanching, scale invariance and universality. Besides physical and biological systems, signatures of self-organized criticality are increasingly found in human dynamics; they are often related to the appearance of fractal patterns and complex network geometries, see [1,2] and references there.

In this lecture, we first present fundamental features of self-organized critical states in different dynamical systems. We show how this physics concept facilitates data analysis and provides evidence of the emergent collective knowledge in the empirical data of a prominent example of human cooperation to create new knowledge [3,4]. We demonstrate self-organized critical behaviours through quantitative data analysis and agent-based modelling. Furthermore, we discuss several open questions, particularly the origin of critical states in social dynamics vs better understood driven physical systems, as well as the essential role of critical fluctuations in them. We highlight the importance of self-similarity in the underlying stochastic process to reveal robust patterns in the empirical data. Furthermore, the universality of critical states helps differentiate relevant parameters that drive the dynamics, thus enabling efficient agent-based modelling simulations and predictions of various scenarios. Finally, regarding the information-theoretic aspects of social dynamics, it is expected that the scale invariance of these critical states optimizes information complexity as a key to the relevance of information stored in the data.

References

1. B. Tadic, R. Melnik, Self-Organised Critical Dynamics as a Key to Fundamental Features of Complexity in Physical, Biological, and Social Networks, Dynamics 1(2), 181-197 (2021)

2. B. Tadic, Self-organised criticality and emergent hyperbolic networks: blueprint for complexity in social dynamics, Eur. J. Phys. 40(2), 024002 (2019)

3. B. Tadic. M. Mitrovic Dankulov, R. Melnik, Mechanisms of self-organized criticality in social processes of knowledge creation, Phys. Rev. E 96, 032307 (2017)

4. M. Mitrovic Dankulov, R. Melnik, B. Tadic, The dynamics of meaningful social interactions and the emergence of collective knowledge, Sci. Rep. 5, 12197 (2015).

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