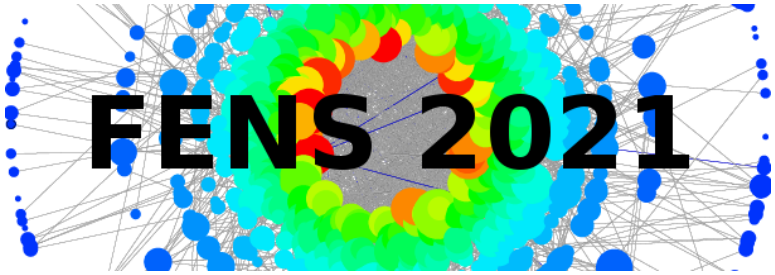

Contribution ID: **48** Type: **Invited talk (40 min)**

Modelling time-varying interactions in complex systems: the Score-Driven Kinetic Ising Model

Thursday, 1 July 2021 16:40 (40 minutes)

A common issue when analyzing real-world complex systems is that the interactions that characterize them often change over time: this makes it difficult to find optimal models that describe this evolution and can be estimated from data, particularly when the driving rules are not known. Here we offer a new perspective on the development of models for time-varying interactions introducing a generalization of the well-known Kinetic Ising Model (KIM), a minimalistic pairwise constant interactions model which has found applications in multiple scientific disciplines. Keeping arbitrary choices of dynamics to a minimum and seeking information theoretical optimality, the Score-Driven methodology lets us significantly increase the knowledge that can be extracted from data using the simple KIM. In particular, we first identify a parameter whose value at a given time can be directly associated with the local predictability of the dynamics. Then we introduce a method to dynamically learn the value of such parameter from the data, without the need of specifying parametrically its dynamics. Finally, we extend our framework to disentangle different sources (e.g. endogenous vs exogenous) of predictability in real time. We apply our methodology to the high-frequency dynamics of stock prices, neuronal activity, extreme events, and temporal networks. Our results show that the Score-Driven KIM produces insightful descriptions of the observed processes, while keeping computational effort at a minimum, suggesting that our approach can be efficiently translated to other fields where the KIM has been extensively used.

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