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Reconstructing Directed Networks From Noisy Dynamics[1] HIU CHING TAM, EMILY SC CHING, Department of Physics, The Chinese University of Hong Kong — Complex systems can be fruitfully studied as networks of many elementary units, known as nodes, interacting with one another with the interactions being the links between the nodes. The overall behavior of the systems depends crucially on the network structure depicting how the nodes are linked with each other. It is usually possible to measure the dynamics of the individual nodes but difficult, if not impossible, to directly measure the interactions or links between the nodes. For most systems of interest, the links are directional in that one node affects the dynamics of the other but not vice versa. Moreover, the strength of interaction can vary for different links. Reconstructing directed and weighted networks from dynamics is one of the biggest challenges in network research. We have studied directed and weighted networks modelled by noisy dynamical systems with nonlinear dynamics and developed a method that reconstructs the links and their directions using only the dynamics of the nodes as input. Our method is motivated by a mathematical result derived for dynamical systems that approach a fixed point in the noise-free limit. We show that our method gives good reconstruction results for several directed and weighted networks with different nonlinear dynamics.

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