

# Dynamic Network Analysis: Model, Algorithm, Theory, and Application

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## Abstract

Across the sciences, a fundamental setting for representing and interpreting information about entities, the structure and organization of communities, and changes in these over time, is a stochastic network that is topologically rewiring and semantically evolving over time, or over a genealogy. While there is a rich literature in modeling invariant networks, until recently, little has been done toward modeling the dynamic processes underlying rewiring networks, and on recovering such networks when they are not observable.

In this talk, I will present two recent developments in analyzing what we refer to as the dynamic tomography of evolving networks. I will first present new sparse-coding algorithms for estimating the topological structures of latent evolving networks underlying nonstationary time-series or tree-series of nodal attributes, along with theoretical results on the asymptotic sparsistency of the proposed methods; then, I will present a new Bayesian model for estimating and visualizing the trajectories of latent multi-functionality of nodal states in the evolving networks.

I will show some promising empirical results on recovering and analyzing the latent evolving social networks in the US Senate and the Enron corporation, and the evolving gene network of fruit fly while aging, at a time resolution only limited by sample frequency. In all cases, our methods reveal interesting dynamic patterns in the networks.