

# Likelihood inference for a large causal network

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## Abstract

Inference of causal relations between interacting units in a directed acyclic graph (DAG), such as a regulatory gene network, is common in practice, imposing challenges because of a lack of inferential tools. In this talk, I will present constrained likelihood ratio tests for inference of the connectivity as well as directionality subject to nonconvex acyclicity constraints in a Gaussian directed graphical model. Particularly, for testing of connectivity, the asymptotic distribution is either chi-squared or normal depending on if the number of testable links in a DAG model is small; for testing of directionality, the asymptotic distribution is the minimum of d independent chi-squared variables with one-degree of freedom or a generalized Gamma distribution depending on if  $d$  is small, where  $d$  is the number of breakpoints in a hypothesized pathway. Computational methods will be discussed, in addition to some numerical examples to infer a directed pathway in a gene network. This work is joint with Chunlin Li and Wei Pan of the University of Minnesota.