Bayesian Discovery of Non-gaussian Vector Autoregressive Models

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Since the seminal work on causal discovery of Shimizu et al. (2006), many authors have proposed extensions to relax some of the hypothesis done by the authors. One of such extensions was done by Hoyer and Hyttinen (2009). The main contribution of their work is to make use of the identification results for Linear non-Gaussian Acyclic Models (LiNGAM) provided by Shimizu et al. (2006), while accounting for parameter and structure uncertainty using a Bayesian setup. One important drawback of Hoyer and Hyttinen (2009) approach is that, since they apply a Bayesian score function procedure to causal discovery, their brute force algorithm to search over the space of possible DAGs is infeasible for more than a handful of variables. This limitation is specially important for Vector Autoregressive (VAR) data-generating processes, in which we typically consider more than one variable together with autoregressive

terms of the variables. One simple but important aspect of time-series processes is that they provided a natural time ordering of variables that can restrict the space of possible DAGS to search in. In this sense, our work seeks to extend the work of Hyvärinen et al. (2010) that defines structure search in a VAR-LiNGAM context, to incorporate structure and parameter uncertainty in a Bayesian framework. To overcome the computational difficulties raised by Hyvärinen et al. (2010), we use the time-ordering aspect of time-series process by implementing the Teyssier and Koller (2005) time-ordering algorithm to search over the space of possible DAGs in a more efficient way.

Keywords: causal discovery, bayesian score, VAR models

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