



# Asymmetric Hidden Markov Models with Continuous Variables\*

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**Abstract**—Hidden Markov models have been successfully applied to model signals and dynamic data. However, when dealing with many variables, traditional hidden Markov models do not take into account asymmetric dependencies, leading to models with overfitting and poor problem insight. To deal with the previous problem, asymmetric hidden Markov models were recently proposed, whose emission probabilities are modified to follow a state-dependent graphical model. However, only discrete models have been developed. In this paper we introduce asymmetric hidden Markov models with continuous variables using state-dependent linear Gaussian Bayesian networks. We propose a parameter and structure learning algorithm for this new model. We run experiments with real data from bearing vibration. Since vibrational data is continuous, with the proposed model we can avoid any variable discretization step and perform learning and inference in an asymmetric information frame.

**Index Terms**—Hidden Markov models, Bayesian networks, Model selection, Structure learning, Time series, Information Asymmetries, Linear Gaussian Bayesian Network