Time-Varying Dynamic Bayesian Networks (ID: 858)

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Problem: Structurally-varying networks needed for modeling evolving relations between non-stationary multivariate time series.

New Formalism: Time-varying DBNs $X^t = A^t \cdot X^{t-1} + \epsilon, \ \epsilon \sim \mathcal{N}(0, \sigma^2 I)$

Structure Learning: Kernel reweighted ℓ_1-regularized autoregression

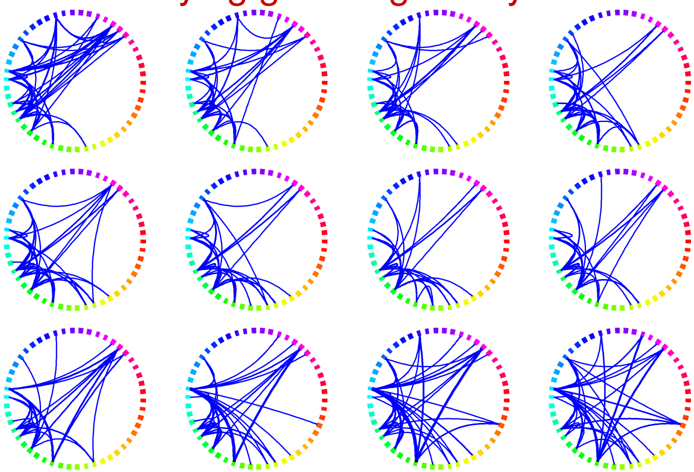
$$\hat{A}_{i\cdot}^{t^*} = \operatorname{argmin}_{A_{i\cdot}^{t^*} \in \mathbb{R}^{1\times n}} \sum_{t=1}^{T} w^{t^*}(t)(x_i^t - A_{i\cdot}^{t^*} x^{t-1})^2 + \lambda |A_{i\cdot}^{t^*}|_1, \ \forall t^* \in [0,1]$$

Properties: Computational efficiency and provable asymptotic sparsistency

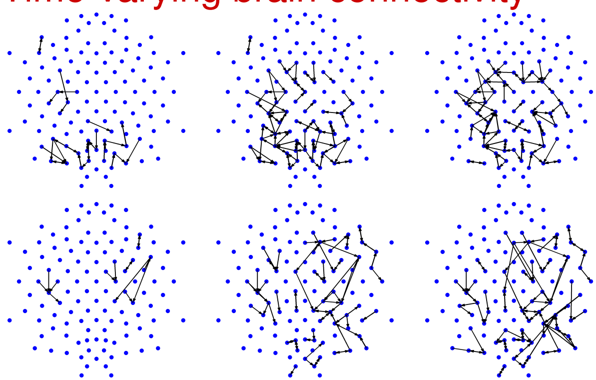
$$\mathbb{P}[\text{supp}(\hat{A}^{t^*}) = \text{supp}(A^{t^*})] \rightarrow 1, \quad T \rightarrow \infty, \quad \forall t^* \in [0,1].$$

Applications: Yeast cell cycle and brain-computer interface data

Time-varying gene regulatory networks



Time-varying brain connectivity



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