Title: A procedure to increase the power of Granger-causal analysis through temporal smoothing

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PII: S0165-0270(18)30217-6
DOI: https://doi.org/10.1016/j.jneumeth.2018.07.010
Reference: NSM 8061

To appear in: *Journal of Neuroscience Methods*

Received date: 26-4-2018
Revised date: 6-7-2018
Accepted date: 14-7-2018

Please cite this article as: Spencer E, Martinet L-E, Eskandar EN, Chu CJ, Kolaczyk ED, Cash SS, Eden UT, Kramer MA, A procedure to increase the power of Granger-causal analysis through temporal smoothing, *Journal of Neuroscience Methods* (2018), https://doi.org/10.1016/j.jneumeth.2018.07.010

Type of article: Research Article

Title: ***A procedure to increase the power of Granger-causal analysis through temporal smoothing***

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I have read and have abided by the statement of ethical standards for manuscripts submitted to the Journal of Neuroscience Methods

- **Elizabeth Spencer**

Highlights

- Modification of multivariate Granger causality for conditional inference on large network data
- Model with interpretable parameters for signals with extended, smooth history dependencies
- Statistically powerful network inference tool more sensitive to detecting network connections

Abstract:

Background: How the human brain coordinates network activity to support cognition and behavior remains poorly understood. New high-resolution recording modalities facilitate a more detailed understanding of the human brain network. Several approaches have been proposed to infer functional networks, indicating the transient coordination of activity between brain regions, from neural time series. One category of approach is based on statistical modeling of time series recorded from multiple sensors (e.g., multivariate Granger causality). However, fitting such models remains computationally challenging as the history structure may be long in neural activity, requiring many model parameters to fully capture the dynamics.
New Method: We develop a method based on Granger causality that makes the assumption that the history dependence varies smoothly. We fit multivariate autoregressive models such that the coefficients of the lagged history terms are smooth functions. We do so by modelling the history terms with a lower dimensional spline basis, which requires many fewer parameters than the standard approach and increases the statistical power of the model.
Results: We show that this procedure allows accurate estimation of brain dynamics and functional networks in simulations and examples of brain voltage activity recorded from a patient