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Detecting couplings between point processes and flows

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The reliable detection of directional couplings from experimental signals is crucial for the study of many systems in nature. These signals can for example be given by sequences of discrete event times of point processes or by time-continuous variables measured from flows. Often experiments yield simultaneous recordings comprising both point processes and flows. The characterization of causal interactions from such signals is key to an advanced understanding of the underlying dynamics. We therefore recently introduced a unified approach to characterize unidirectional couplings between point processes, between flows, as well as between point processes and flows [1]. For this purpose we showed and exploited the generality of the asymmetric state similarity conditioning principle. We used Hindmarsh-Rose neuron models and Lorenz oscillators to illustrate the high sensitivity and specificity of our approach. We here review this novel methodology and show first applications to real-world experimental dynamics.

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References

[1] Andrzejak and Kreuz, EPL, 96 (2011) 50012