A Spatial-Temporal-Relational Point Process for Pairwise Event Data

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Pairwise interaction data, containing events involving pairs of actors over time and space, are now commonly available at the finest of temporal and spatial resolutions. Researchers are typically interested in both understanding the structure of interactions within a pair of actors and the dependencies among actor interactions, i.e. how one interaction affects the probability of subsequent interactions in the population. While these data sets are often modeled in discrete-time, continuous-time models are needed to fully exploit the richness of information in the spatial-temporal structure.

Existing continuous-time methodology directly model interaction "contagion" using point processes, whereby one interaction increases the propensity of interactions among all other pairs of actors according to a parameter specific to the actor pair involved in the observed interaction and the pair in the potential interaction. This influence often decays over time and space aligning with the belief that dependencies in interactions are characterized by strong immediate geographically-local influences which atrophy. In order to parsimoniously capture actor dependencies, models have been proposed that assume an underlying social network structure which dictates the contagion process. Specifically, given an interaction between an actor pair, the propensity for interaction increases only between actors who are tied in the network to either of the actors in the observed interaction. A key drawback to this approach is that the pattern of interaction between an actor pair and the interaction dependencies are confounded in the underlying network.

In this talk, we present a novel spatial-temporal-relational point process model for continuous-time event data which characterizes interaction patterns between a pair of actors as either spurious or that resulting from an underlying, meaningful connection in a latent social network. We argue that the consistency of interactions, rather than their frequency, is most indicative of a well-established underlying social relationship between the actors. Consequently, actors that are connected in the latent social network can assume interaction patterns with any frequency. Dependencies between interactions in the network are decomposed into that attributable to actor spatial locations and that resulting from social processes in the underlying network.

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