4th YSM-SPIP in Sendai/Prologue Series IV of FSPIP

A centrality measure of interaction events in temporal networks

Taro Takaguchi[1], Nobuo Sato[2], Kazuo Yano[2], and Naoki Masuda[1,3]

[1]Department of Mathematical Informatics, The University of Tokyo
[2]Central Research Laboratory, Hitachi, Ltd.
[3]PRESTO, Japan Science and Technology Agency

Data derived from social interactions, such as face-to-face conversations, e-mail exchanges, and phone calls, have been accumulated in the form of time-ordered sequences of events between pairs of individuals. Such data are collectively called temporal networks [1], whereby the links with time stamps are assumed between pairs of nodes (*i.e.*, individuals) involved in interaction events. We propose a centrality measure for each interaction event [2]. We assume that an event is important if it conveys new information about others to the two individuals involved in the event. We define the importance of event by generalizing the concept of advance of event [3] to the case in which an individual can be involved in multiple events in a single time unit.

By applying the proposed importance to the real data sets, we find that the measure adequately represents the centrality of each event in the following sense. When we remove a small fraction of events with large importance values, the connectivity of the remaining temporal networks is drastically decreased. By contrast, the connectivity changes little when we remove a large fraction of events with small importance values (the robustness property). It should be noted that this analysis is similar to the intentional attacks against nodes and links in static networks. We perform the same event removal analysis for the randomized event sequences to investigate the origin of the robustness property. The discovered origins are also discussed in the presentation.

References

[1] P. Holme and J. Saramäki, Phys. Rep. **519**, 97 (2012).
[2] T. Takaguchi *et al.*, New J. Phys. **14**, 093003 (2012).
[3] G. Kossinets *et al.*, in Proceedings of the 14th ACM SIGKDD international conference on Knowledge discovery and data mining, p. 435, (2008).