Review of "Temporal Networks by Holm, P., and Saramäki J."

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A Graph consists of set of vertices, the units of the system, and a set of edges, the pairs of vertices that are interacting with each other that represents the network for example disease spreading on social networks. This type of networks helps us to understand how much one part of the network influences another or which vertices play similar roles in the systems operation etc. Now, if we can integrate another dimension, "Time", then this type of networks called temporal networks. In static networks, whether directed or not, it is considered that if the nodes follow transitivity property i.e. $A \rightarrow B$ and $B \rightarrow C$, implies $A \rightarrow C$ (indirectly through path B). However, in temporal networks, if the edge (A, B) is active only at a later point in time than the edge (B, C), then A and C are disconnected. In traditional network modeling one separates the underlying static network and the dynamical system on the network. On the other hand, temporal network methods consider when things happen from the dynamical system to the network. There are different types of temporal networks including Person-to-person communication, One-to-many information dissemination, Physical proximity, Cell biology, Distributed computing, Infrastructural networks, Neural and brain networks, Ecological networks etc.

There are two classes of representations for the temporal networks. In the first class includes vertices interacting with each other at certain times and the durations of the interactions are negligible e.g. emails, phone calls, text messages etc. In the second class, edges are active over a set of intervals instead of set of times e.g. proximity networks, seasonal food webs, infrastructural systems like internet.

There are lot of measures for topological structure of a static networks based on connections between neighboring nodes or between larger sets of nodes. However, for the temporal networks, it is important to incorporate the concept of time. These topological structure measures can be grouped based on as (i) Time-respecting paths and reachability, (ii) Time-respecting paths with limits on waiting times, (iii) connectivity and components, (iv) Distances, latencies and fastest paths, (iv) Average latency, (v) Diameter and network efficiency, (vi) minimum spanning tree, (vii) Centrality measures. The models that is used for the temporal networks broadly classified as temporal exponential random graphs, models of social group dynamics and randomized reference models [1].

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References

[1] P. Holme and J. Saramäki, "Temporal networks," *Physics reports*, vol. 519, no. 3, pp. 97–125, 2012.