論 文 の 内 容 の 要 旨

論文題目　　Visualizing Dynamic Networks using Matrix Technology

　　　　　　（行列技術を用いた動的ネットワーク　可視化）

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This dissertation makes contributions to the field of dynamic network visualization related to knowledge discovery and analysis within evolution of community structure over time. Our approach provides a framework involving three levels of dynamic network visualization as a circle of data analysis: underlying algorithms processing large-scale data streams as the lowest level, appropriately designed visual interface including all the human-computer interactions as the middle level, and exploring method with pattern of potential discoveries as the highest level. Experiments are conducted for evaluating the approach from different angles.

In this work, I present both the two underlying algorithms for data processing. One is the dynamic matrix seriation algorithm for arranging the visualization layout over time. Comparing with previous outstanding algorithms in this field, our approach makes consideration of both the smoothness of matrix permutation and the highlight of hidden patterns at the same time. Another algorithm is for detecting the evolution of network community structure overtime, where the main idea of algorithm is dynamically capturing the splitting/merging events of communities. Performance of our algorithm is proved to be more stable when networks are more complex with vague boundaries between communities. Meanwhile, I also present a 2-dimensional, matrix-like, and animation-based design of visualization, where each decision of feature selection is for the purpose of reducing the interface cost of computation and the learning cost of users. Finally, I present a pattern of potential meaningful knowledge on the visualization, which is inspired by the process of chance discovery via KeyGraph.

Together, this visualization approach suggests a way of knowledge discovery over rapid data stream of networks, and we suggest the application of our approach is in domain of real-time analytics on big data. Potential application scenarios on real world tasks and future research directions are discussed.