COMMUNITY STRUCTURE IN A LARGE-SCALE TRANSACTION NETWORK AND VISUALIZATION

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We analyze a transaction network of about 780 thousand Japanese firms and find its community structure. Finding community in network means the appearance of dense connected groups of vertices and sparse connections between groups. The quality function of the community is called modularity that is proposed by Newman [1]. The optimization of the modularity is one of effective approaches to find community.

We first use a bottom-up algorithm of Clauset *et al.* [2], which makes the optimization fast by using a greedy algorithm. However, this algorithm may not sufficiently optimize modularity because the optimization tends to be trapped by a local maximum especially on large-scale networks. Alternatively we propose a top-down algorithm that implements the annealing method. Then we compare effectiveness of the two algorithms.

We also compare the results of the community analysis with those of the visualization by molecular dynamics method. The optimized network structure based on the molecular dynamics is shown in Fig. 1, where we discriminate the largest community from others through change of the color. The vertices belonging to the same community are located close to each other as shown in Fig. 1.
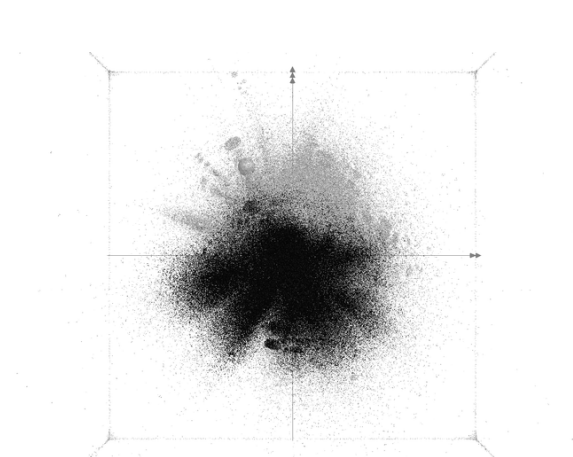

Figure 1: The largest community in the network. (black)

Keywords
transaction network, community structure, modularity, visualization

References
[1] M. E. J Newman, Phys. Rev. E **69**, 066113 (2004).
[2] A. Clauset, M. E. J Newman, and C. Moore, Phys. Rev. E **70**, 066111 (2004).

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