STRUCTURE ANALYSES OF A LARGE-SCALE TRANSACTION NETWORK THROUGH VISUALIZATION BASED ON MOLECULAR DYNAMICS

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Various systems as encountered in informational, social, economical, and biological sciences are recognized as networks consisiting of an enormous number of linked elements. It is, however, highly difficult to analyze all connections because of their multitude and complexity. Visualization is one of useful techniques to illuminate structural properties of networks [1].

The objective of the present work is to develop a visualization method adapted for drawing large-scale networks and to apply the method so obtained to a transaction network of about 800,000 firms in Japan. The data we use almost exhausts the whole production activity over the nation. Here we assume the spring-electrical model to visualize the network, in which linked firms are connected with a spring and all of firms repels each other through a repulsive Coulomb interaction. We take full advantage of molecular dynamics (MD) for an optimized structure in the model. The MD works well to reproduce ordered structures through slow cooling starting from a given initial configuration. We thus expect it is also successful in visualizing network structures.

We exemplify an optimized structure of the transaction network in Japan obtained by the MD simulation in Fig. 1. The distribution of firms is also decomposed into various sectors of industry. We see that each component has its own characteristics. This figure thus constitutes an industrial map in Japan.

Keywords
transaction network, visualization, molecular dynamics

References
[1] Yifan Hu, The Mathematica Journal, **10** (2006) 37.

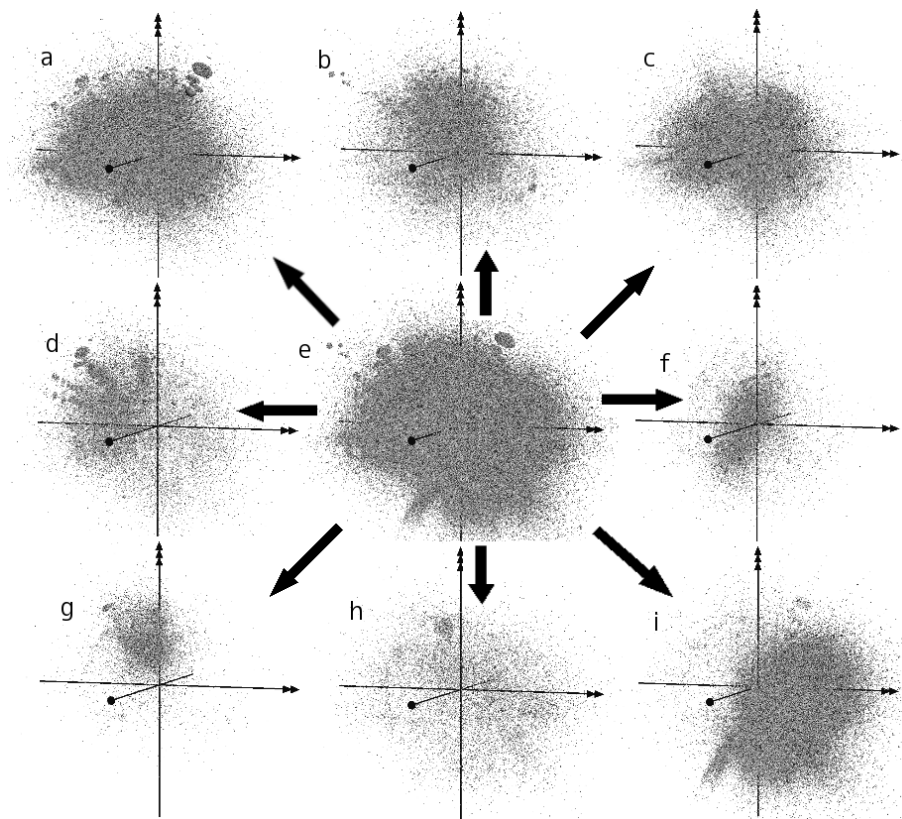*Corresponding author. E-mail address: hiyetomi@sc.niigata-u.ac.jp

Figure 1: Industrial map in Japan decomposed into various sectors; (a) wholesale/retail trade, (b) services, (c) manufacturing, (d) others, (e) all industry, (f) transport, (g) information/communications, (h) real estate, (i) construction.