Extinction of Links and Resulting Percolation in a Japanese Business Relation Network

Hirokazu KAWAMOTO*[1], Hideki TAKAYASU[2,3] and Misako TAKAYASU[2]

[1] Department of Computational Intelligence and Systems Science, Interdisciplinary Graduate School of Science and Engineering, Tokyo Institute of Technology 4259, Nagatsuta-cho, Yokohama 226-8502, Japan

[2] Institute of Innovative Research, Tokyo Institute of Technology 4259, Nagatsuta-cho, Yokohama 226-8502, Japan

[3] Sony Computer Science Laboratories, 3-14-13, Higashi-Gotanda, Shinagawa-ku, Tokyo 141-0022, Japan

E-mail: *kawamoto@smp.dis.titech.ac.jp

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We have studied a percolation process in a Japanese business relation network based on simulation for clarification of network robustness and a new evaluation technique of firms. First, we revealed physical properties of the percolation transition on the process removing links randomly by precise calculation [1]. This paper showed that order parameters around the transition represent the characteristic of divergence (Fig. 1) and its system-size dependence is observed by the finite size scaling. Second, we introduced a novel indicator, network survival rate which evaluates robustness of each nodes as an application [2]. This technique enables to extract distinctive nodes which have many trading firms, but are fragile, by choosing a high link node with small network survival rate. In addition, regional robustness is discussed by analyzing these calculated indicators.

Although the studies based on numerical calculation have been proceeding in this way, little is known about the process of extinction of links in a real business network except the survey of links' life time distribution [3]. Here, we focus our attention to extinction of links in the business network, and we construct a virtual network consisted of extinguished links. This is a kind of ghost network accompanied with the time evolving real network, and we study its basic properties. Moreover, we discuss its relations with the percolation transition.

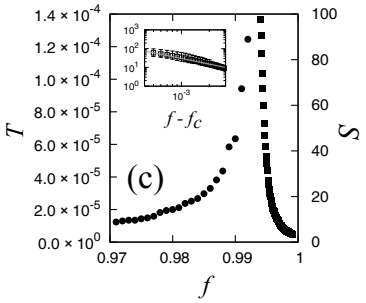

Figure 1. Divergence of fluctuation sizes of network clusters as a function of link removal probability consistent with the percolation theory [1].

References

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