ネットワークモデルによって捉えるイノベーター理論とキャズム理論

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Early adopter and chasm found in a numerical network model

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Abstract: A network model of scientific paradigm shifts proposed by S. Bornholdt et al. (2011) was modified and extended to a modeling of prevailing trends such as music CDs in good demand, in which a mean-field state update is replaced by a state update depending only on nearest-neighboring nodes on a small-world network. The modified model is also used to establish a connection with diffusion of innovations as well as early adopter introduced by Everett M. Rogers, and with chasm as pointed out by Geoffrey Moore. Real commercial data of sales results of music CDs on major and independent labels are used for comparison between the original mean-field model and the modified small-world model.

Keywords: Paradigm Shift, Small World, Diffusion of Innovations, Early Adopter, Chasm

1. Model of Paradigm Shifts

A network model of scientific paradigm shifts by S. Bornholdt et al. [1] has the following characteristics:

(1) A scholar interacts with the nearest-neighbor four scholars on a square lattice.

(2) A scientific paradigm of accepted by a scholar is accepted by a nearest-neighbor scholar with a probability proportional to the ratio of the number of scholars accepting the same paradigm to the whole.

(3) An existing paradigm is never reproduced.

2. Modified Model

Yamada modified the above-mentioned model [2], in which

(1) By use of the terminology of cellular automata, the von Neumann neighborhood (square lattice with four neighbors) is replaced by the Moore neighborhood (square lattice plus diagonals with eight neighbors) as an interaction range, in order easily to obtain the cluster coefficient of the Watts-Strogatz small-world network model by constructing a triangular lattice.

(2) The Moore neighborhood (link) is rewired in analogy with the Watts-Strogatz model, so that some of the Moore neighborhood are replaced by the short-cut neighbors.

(3) A scientific paradigm of accepted by a scholar is accepted by a nearest-neighbor scholar with a probability proportional to a function of the ratio of the number of *directly connected* scholars accepting the same paradigm to the whole number of *directly connected* scholars. The function in the form of a Fermi distribution function in the field of quantum statistical mechanics has two parameters: *inverse temperature* (a degree of synchronization) and *chemical potential* (a threshold above which a scholar easily accepts the paradigm accepted by the nearest-neighbor scholars). This modification enables us to generalize a scholar accepted a specific scientific paradigm to an ordinary person, with a specific opinion, infected by a specific contagion disease, and purchasing a specific music CD.

3. Rogers and Moore

Diffusion of Innovations is first explained in the book written by Everett Rogers [3], in which the importance of the *early adopter* is stressed [3]. Furthermore, Moore introduced the notion of *Crossing the Chasm* in the literature [4]. These *Diffusion of Innovations*, *Early Adopter* and *Crossing the Chasm* is verified by used of the modified network model.

4. Real Commercial Data

The sales results of music CDs on major and independent labels in the commercial site of *amazon* are used for comparison between the original mean-field model and the modified small-world model.

References

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