学　位　論　文　内　容　の　要　旨

博士の専攻分野の名称　　博士（情報科学）　　氏名　陳　鶴

学　位　論　文　題　名

Research on Statistical Mechanics of Labor Markets Based on Simulation Substantiated by Actual Data

（実データに基づくシミュレータ構築による労働市場の統計力学に関する研究）

This thesis provides theoretical studies on labor markets incorporating econophysics through statistical mechanical approaches.

Physical science researchers have long had a reputation of meddling in areas outside the restricted domain of physical science. In some cases, the non-traditional approaches that researchers introduce can result in new insights, and in due course, this new inter-disciplinary area of research can become a recognized part of science. However, econophysics, the use of physical theories and methods developed by physicists to understand economic phenomena and solve economic problems, leads to a development of interdisciplinary research field. It is rooted in statistical mechanics, and some of its applications to the study of economics are usually including uncertainty or stochastic processes and nonlinear dynamics.

Based on the statistical mechanics, we introduce a probabilistic agent-based model of labor markets for university graduates, in particular, in Japan. To make an effective model of the market, with several hypotheses, we construct the local energy function of each company and describe the probability that an arbitrary company gathers students at each business year by a Boltzmann-Gibbs distribution.Inspired by the unsupervised learning or self-organization in the machine learning context, we attempt to draw a ‘learning curve’ for the collective behavior of job-seeking ‘non-intelligent’ labors in successive job-hunting processes. In our model, the diversity of students’ behavior is built-in by means of the Jaynes-Shannon’s MaxEnt (Maximum Entropy) principle. We discuss the speed of convergence for the error-measurement, where we consider a scenario in which the students do not use any information about the result of job-hunting in a previous process. Our approach enables us to examine the existence of the condition on which macroscopic quantity, say, ‘stage-wise unemployment rate’ becomes ‘scale-invariant’ in the sense that it does not depend on the job-hunting stage. From the macroscopic view point, the problem could be regarded as a human resource allocation.

We provide a mathematical model to investigate the human resource allocation problem for students. The basic model is described by the Potts spin glass which is well known in the research field of statistical physics. In the model, each Potts spin represents the action of one student, and it takes a discrete variable corresponding to the company he/she applies for. We construct the energy to include the distinct effects on students’ behavior. The correlations (the adjacent matrix) between students are taken into account through the pairwise spin-spin interactions. We carry out computer simulations to examine the efficiency of the model. We also show that some chiral representation of the Potts spin enables us to obtain some analytical insights into our labor markets.