【Grant-in-Aid for Scientific Research(S)】

Integrated Science and Innovative Science (Comprehensive fields)

Title of Project： Establishing Theory of Resource Allocation Mechanism Design for Sustainable Development

Makoto Yokoo
(Kyushu University, Graduate School of Information Science and Electrical Engineering, Professor)

Research Area：Computer Science, Micro Economics
Keyword：Game Theory, Combinatorial Optimization

【Purpose and Background of the Research】

How to allocate precious resources including human becomes critical due to various pressing social issues, including energy, environmental, and aging population issues.

A resource allocation problem is formalized as a combinatorial optimization problem in computer science. Due to recent progress in combinatorial optimization, we can solve large-scale application problem instances in a reasonable amount of time. However, one limitation of existing optimization research is, we usually assume there exists only one agent who makes his/her decision in an environment; we do not consider a situation in which multiple agents with different goals exist.

On the other hand, one central topic in micro economics research is, how precious resources and the products made from these resources are allocated, and what kind of allocations is socially desirable, when multiple agents exist with different goals. In particular, a subfield of micro economics called mechanism design aims to analyze/design resource allocation mechanisms based on game theory founded by John von Neumann. However, one limitation of existing works on mechanism design is that they concentrate on the theoretical properties of mechanisms, e.g., whether a mechanism that satisfies some theoretical properties exists under certain assumptions. As a result, the feasibility of mechanisms has not been examined carefully.

This project will develop the theory of resource allocation mechanism design, which aims to make desirable decisions considering economic, social, and environmental needs when multiple agents exist, by synthesizing/extending technologies from computer science and micro economics.

【Research Methods】

This project will develop the following three types of key technologies.

(1) design technologies, which enable us to design resource allocation mechanisms that incorporate various constraints and agent preferences, and can be executed in a reasonable amount of time.

(2) analytic technologies, which accomplish systematic analysis of the robustness of mechanisms, considering the interaction among multiple mechanisms.

(3) representation technologies, which enable us to concisely represent the input parameters of mechanisms so that optimization mechanisms can be efficiently executed and analyzed by utilizing/extending the knowledge representation technologies developed in Artificial Intelligence.

【Expected Research Achievements and Scientific Significance】

This project will develop the theory of resource allocation mechanism design. As well as theoretical works, it will develop mechanisms for various application domain and software packages, which can be used by domain experts.

By applying these technologies to pressing social issues, the allocation of precious resources can be optimized. As a result, this project will create a paradigm shift, in which ad-hoc resource allocation methods based on past experiences and vested interests will be replaced by mathematically well-founded methods.

【Publications Relevant to the Project】

・Makoto Yokoo, Pseudonymous Bidding in Combinatorial Auctions, in Combinatorial Auctions, Peter Cramton, Yoav Shoham and Richard Steinberg, eds. MIT Press, 2006.
・Makoto Yokoo, Yuko Sakurai, and Shigeo Matsubara, The Effect of False-name Bids in Combinatorial Auctions: New Fraud in Internet Auctions, Games and Economic Behavior, vol. 46, No. 1, 174-188, 2004.

【Term of Project】 FY2012-2016

【Budget Allocation】 163,500 Thousand Yen

【Homepage Address and Other Contact Information】

http://agent.inf.kyushu-u.ac.jp/~yokoo/