Interdisciplinary Area

Title of Project : Initiative for High-Dimensional Data-driven Science through Deepening of Sparse Modeling

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【Purpose of the Research Project】

The main purpose of this project is to develop the innovative methodology for understanding the world of nature by tight fusion of information science and natural science. Our scientific research area focuses on 'Sparse Modeling' that based on fundamental principle of sparseness: most of useful information is embedded in the low-dimensional subspace for high-dimensional observation data in the various fields of natural science.

By collaboration between natural scientists and information scientists through sparse modeling and by deepening the mathematical basis of sparse modeling, we will create an innovative scientific area which should be called as high-dimensional data-driven science, and will establish an overwhelming international lead of academic standard of Japan for the coming paradigm of data-intensive sciences.

【Content of the Research Project】

In order to establish the high-dimensional data-driven science, we propose three major strategic objectives of this research project as follows (Fig. 1):

A: Practice of data-driven science
B: Establishment of modeling principle
C: building of mathematical foundation

For these three aims, we have set up the following three subproject groups, respectively: Experiment and Measurement Group (A01, A02), Modeling Group (B01) and Information science Group (C01). Especially, Modeling Group (B01) plays an important role as the interface and catalyst for tight fusion between natural science and information science.
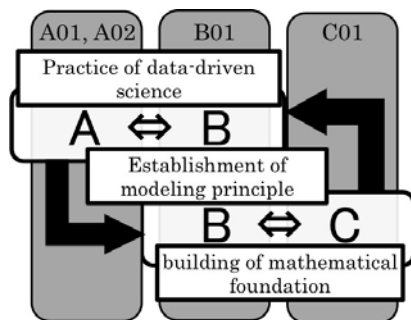

Fig. 1: Research system diagram of this project

【Expected Research Achievements and Scientific Significance】

Experiment Group (A01, A02) will cause breakthrough in life sciences, geosciences and astrology, by establishing the scientific methodology, through which we can discover new scientific insights and speed up the experimental protocols dramatically.

For example, astrology team (A02-3) tries to picture the black hole directly using sparse modeling from data sets acquired by radio interferometer (Fig. 2).

Modeling Group (B01) investigates the system-scientific methodology which links the individual data sets in natural sciences and universal data-analyzing technique, and will propose universal framework which enables us to model target phenomena and systems based on hypothesis and test cycles. It will result in establishment of new approach to understanding nature, called as data-driven phenomenological theory that utilizes analogy and universality for solving the individual problems by jumping the barrier of scientific discipline.

Fig. 2: conceptual drawing of a black hole.

Information science Group (C01) reforms the classical theory of multivariate analysis by solving specific problems with high-dimensional scientific data including non-linearity and uncertainty, and will establish the mathematical basement of sparse modeling.

【Key Words】

Sparse modeling, High-dimensional data-driven science, Compressed sensing, Sparseness

【Term of Project】 FY2013-2017
【Budget Allocation】 1,022,000 Thousand Yen
【Homepage Address and Other Contact Information】

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