

Title of Project : From molecules and cells to organs: trans-hierarchical logic for higher-order pattern and structures

Term of Project : FY2010-2014

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[Purpose of the Research Project]

In a multi-cellular organism, groups of cells produce higher-order patterns and structures during development. To explore this order formation, we need logics that explain the processes of trans-hierarchy from the level of molecules and cells to entire organs. For this, we need to introduce mathematical modeling and establish as-yet-unknown parameters relating to physical properties of cells such as force and deformation. In our research project, we strongly encourage researchers with excellent experimental systems to collaborate with theoretical biologists as well as engineers specializing in measuring physical properties of cells and tissues. This inter-disciplinary collaboration will enable us to build up theoretical models utilizing novel as well as essential parameters extracted from the current accumulated wealth of molecular and information, cellular perform and cross-validation between in vivo and in silico. In doing so, we will gain a greater understanding of the mechanistic logic of macro-level pattern formation based on molecules and cells in biological systems.



[Content of the Research Project]

To explore the logics of macro-level pattern formation and organognesis from micro-level components such as molecules and cells, we set up two research teams, A01 "Elucidation of trans-hierarchial logics in biological systems" and A02 "Development of mathematical modeling and measurement of novel cellular parameters in biological systems". Team A01 researchers explore trans-hierarchial logics in their experimental systems, if necessary, with support from team A02. Team A02 researchers develop mathematical modeling, techniques tools for measuring novel cellular and parameters in collaboration with team A01. In particular. Dr. Shigeru Kondo (Osaka University) and Dr. Takeo Matsumoto (Nagoya Institute of Technology) in team A02 are in charge of mathematical modeling and measurement of physical properties of cells and tissues, respectively.



[Expected Research Achievements]

project Our research will elucidate trans-hierarchial logics governing pattern and organ formation that are applicable to diverse aspects biological pattern formation. of Defining these logics is necessary for analyzing intriguing phenomena observed in multi-cellular organisms such as a drastic morphological change resulting from a subtle change in cellular properties and the precise pattern formation in the presence of biological noise. Incorporating the physical properties of cells and mathematical modeling of biological processes, if widely recognized, would become a standard research approach in various fields of life science.

[Key Words]

Organogenesis, Migration, Pattern formation, Cell polarity, Biomechanics, Theoretical biology, Biological measurement

[Homepage Address]

http://www.morphologic.jp/