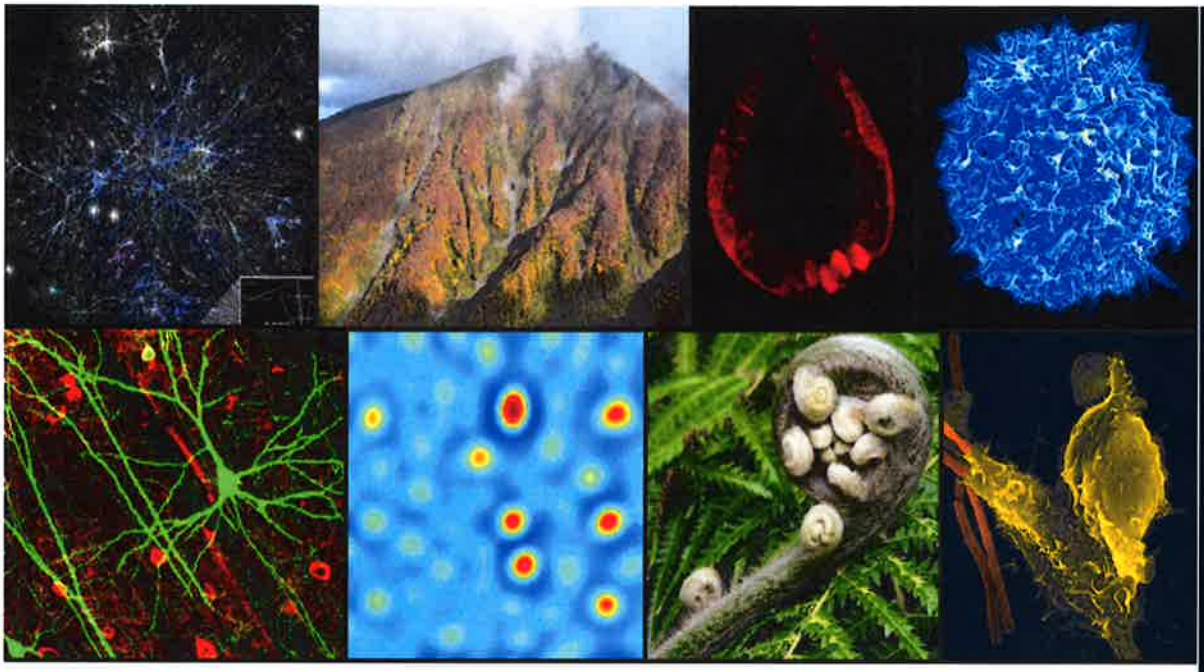

The 2nd Symposium on

COMPLEX BIODYNAMICS & NETWORKS

PROGRAM & ABSTRACTS

TSURUOKA, JAPAN
MAY 11th – 13th
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BIOLOGICAL NETWORKS II

A Multi-Agent Approach for Virtual Tissue Morphogenesis

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We present here an approach of virtual tissue morphogenesis mainly based on multi-agent modelization and simulation. Computer simulations must be efficient and provide the possibility to simulate large tissue containing thousands of virtual cells. In our work, these cells are represented by agents which are able to modify their membrane shapes thanks to a biomechanical model based on a mass/spring system. These agents are also able to exhibit basic cell behaviors such as cell motility, mitosis and adhesion. They also have the capacity to evaluate the compression/stretching and shearing forces applied to them. Let us note that, in order to achieve the computation of thousands of virtual cells, we propose a parallel implementation of our simulator using the OpenCL framework which allows the use of various architectures such as Graphic Cards or Multi-Core Processors. In order to achieve a specific tissue form during morphogenesis, we set the hypothesis that beyond the influence of mechanical forces and gene expression, spatial constraints applied to the cells over time play a key role in the acquisition of a specific form. We consider that, at the early stage of embryogenesis, these constraints are implied in the fundamental principles of form emergence. In our model, it is due to these constraints that cells choose a particular direction while dividing, migrate or die. Our approach of morphogenesis based on constraints has been used to get effectively all possible phenotypes at any stage of the early embryogenesis and their associated genotypes. Such work allows us to do some pattern prediction and to define novel properties on tissues for the purpose of classification.