

## 【Grant-in-Aid for Transformative Research Areas (B)】

### Section II



**Title of Project :** Science for virtual human development:  
**Organ(s)-on-a-chips reveal systemic metabolic networks**

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#### 【Purpose of the Research Project】

As an approach to understanding the human body through science and engineering, we aim to construct a virtual human that mathematically describes various responding reactions. The non-linear and dynamic response of the living body is reproduced to understand the rationality acquired by the living body.

Once mathematical models are sufficiently validated and the behavior of molecular networks is virtually reproduced, the data-driven science is realized. We will develop mathematical models, highly-sensitive omics-based measurement, and various types of organs-on-a-chip.

Such approaches potentially become a novel academic discipline that includes medicine, informatics, analytical science, and pharmacy, while being based on science and engineering, and finally, we will establish the “science of virtual humans”.

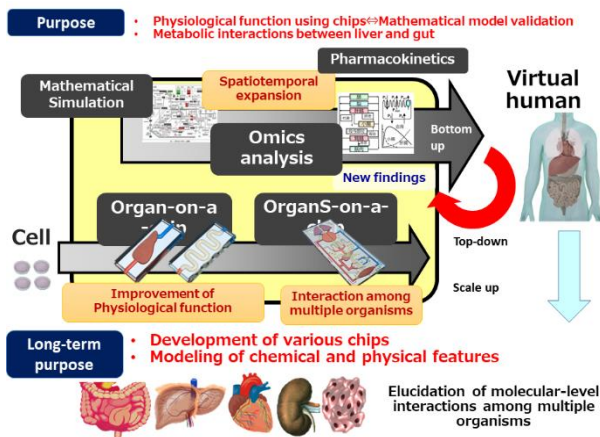


Figure 1. Overview

#### 【Content of the Research Project】

Metabolic pathways were virtually reproduced using mathematical models and chip technologies. The physiological function of each chip will be improved, and subsequently, the multiple chips will be linked. Highly sensitive omics technology will analyze the molecules which induce the interactive reactions among organisms. Mathematical simulation models are also validated and will be used to analyze the robustness and fragility of biological systems. The interactive development and validations will accurately reproduce the dynamic responses of the systems.

#### 【Expected Research Achievements and Scientific Significance】

The development and validation of mathematical simulation, highly sensitive omics, and organs-on-a-chip will yield the following.

First, the result of the new methodology for understanding the human body. These results will contribute to the sciences in physiology, medicine, and pharmacy, etc. The discrepancy between the current *in vitro* experimental system and the actual human body will be decreased. The methods to be developed will be used in pharmaceuticals, foods, chemical substances, and use as individual disease models.

Second, the mathematical model, measurement methods, and experimental systems will be used in the various fields. The integration of these research results will realize data-driven biosciences.

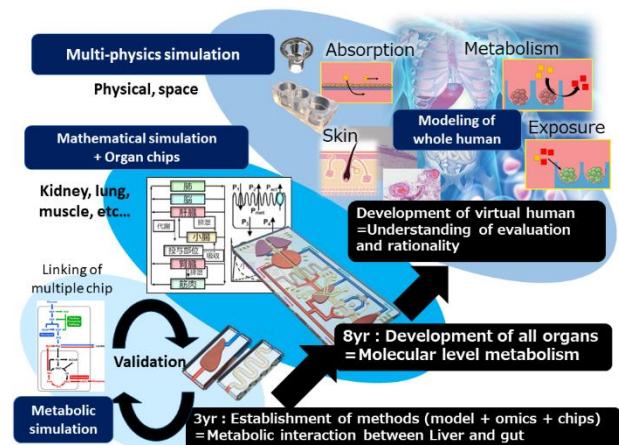


Figure 2. Expected achievements

#### 【Key Words】

Mathematical model, Systems biology, Organ-on-a-Chip, OrganS-on-a-Chip, metabolome

【Term of Project】 FY2020-2022

【Budget Allocation】 121,900 Thousand Yen

#### 【Homepage Address and Other Contact Information】

<https://www.kasojintai.com/>