

Structuring Spatiotemporal Environmental Information in the Body Using In-body Cybernetic Avatars.

Project manager

(selected in 2022)

ARAI Fumihito

Dept. of Mechanical Engineering,
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Leader's institution

The University of Tokyo

R&D institutions

The University of Tokyo,
Tohoku University,
Kyoto University,
Nagoya Institute of Technology,
Nagoya University,
Otsuka Pharmaceutical Co., Ltd.,
FUJIFILM Corporation,
Shibaura Institute of Technology,
JAPAN LIFELINE Co., Ltd.

Summary of the project

We will realize an in-body cybernetic avatar (in-body CA) that operates on the millimeter, micro, and nano scales in vivo, acquires internal information such as body temperature and pH, and can administer drugs locally. This makes it possible, for example, to monitor information about the internal environment that changes over time and space and to understand it in an easy-to-understand manner. If this is applied to health monitoring, new health monitoring and diagnosis methods that can be performed at home will be realized. By realizing in-body CA, we will realize a safe society where daily life will be changed in terms of health maintenance.

Milestone by year 2030

By using in-body CA, it is possible to reach microsites in vivo and monitor health. By dynamically and accurately measuring and monitoring the internal environment of multiple small CAs, it is possible to grasp the daily health status of individuals and their recovery from poor physical condition and illness. Even if the patient becomes ill, the field of view will be expanded by using the small CA group that is remotely controlled, and there will be no oversights in the examination. As a result, it is possible to perform diagnosis, administration, and sampling of the inside of the body, which is usually difficult, accurately and quickly, and to diagnose tissues and cells in a living body, shortening examination time and reducing pain. A plurality of specialists distributed in remote locations can share their specialized knowledge and perform collaborative diagnosis while staying at home. As a result, we can make good use of our time, enjoy our leisure time, and do what we like. In addition, we can live a secure, safe, and comfortable life.

Milestone by year 2025

In-body CA makes it possible to measure the internal environment and position necessary for health monitoring. A group of small CAs will dynamically and accurately measure and monitor the internal environment, and a technology for pinpoint administration within the body will be realized. In addition, the operability of teleoperation devices will be improved, and the technology necessary for biological tissue diagnosis of tissues and cells that

are usually difficult to collect will be developed, reducing the burden.

Project structure

PM Fumihito Arai
(Univ. Tokyo, Eng.)

- Management meeting
- Intellectual property management meeting
- Support team

R&D Topic 1: Integration of In-Body CA (Establishment of technology basis for elemental technology and system integration of millimeter-, micro-, and nano-scale CA)

Actuation
Fumihito Arai
(U. Tokyo, Eng.)



Cooperated control
Ichiro Sakuma
(U. Tokyo, Eng.)



Functional device
Yoichi Haga
(Tohoku U., Biomed Eng.)



Biomaterials
Taichi Ito
(U. Tokyo, Eng.)



Sensing
Kiichi Niitsu
(Kyoto U., Inf. Sci.)



Position measurement
Daisuke Anzai
(Nagoya Inst. Tech.)



R&D Topic 2: Structuring spatiotemporal in-body information and Teleoperation (Establishment of technical basis for interaction by Structuring spatiotemporal in-body information, Teleoperation and Functional evaluation)

In-body information
Kensaku Mori
(Nagoya U. Inf. Sci.)



Teleoperation
Tadayoshi Aoyama
(Nagoya U., Eng.)



Functional evaluation
Hisataka Maruyama
(Nagoya U., Eng.)



R&D Topic 3: Health and Medical Demonstration with In-Body CA (Design, implementation, and evaluation technology of in-body CA and establishment of social infrastructure considering social acceptability)

Design and Evaluation
Mitsuhiro Fujishiro
(U. Tokyo, Med.)



Medication, Evaluation
Hiroki Kawashima
(Nagoya U., Med.)



Practical Application
Shinya Yoshida
(Shibaura I.T., Eng.)



Evaluation of sensing
Koji Onishi (Otsuka Pharmaceutical)



Evaluation Support
Satoshi Ozawa
(FUJIFILM)



Base devices
Kenji Mori
(JAPAN LIFELINE)



R&D Topic 4: Basic research and technology of in-body CA (Research and development of basic research and technology, and investigation of related research trends for in-body CA that contributes to prevention, diagnosis, and health maintenance)

Basic research and Technology, Fumihito Arai (U. Tokyo, Eng.)