

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

1. Position in the program

As a vision of society in 2050, we aim to realize a safe, secure, and comfortable daily life. Our project aims to realize a society that is useful for maintaining a safe, secure, and healthy daily life, and it is necessary to maintain a balance between not only the material richness that comes from productivity efficiency alone, but also the spiritual richness and comfort that comes from leisure time and inefficiency. For human happiness, it is important to maintain a good condition physically, mentally, and socially, that is, well-being. Above all, keeping your mind and body healthy is essential for maintaining a happy life. In this project, 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 vivo CA, we will realize a safe society where daily life will be changed in terms of maintaining mental and physical health.

2. Overview of the R&D and the Challenges

In-body CA is a CA that can be operated remotely from the outside safely and securely to know the conditions inside the body, such as the internal organs and the digestive system, and interact with it in the body.

In-body CA integrates:

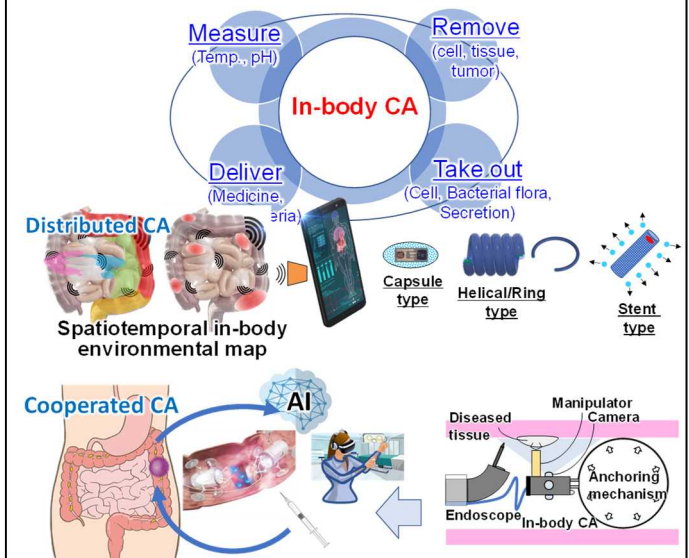
1. A group of small CAs that operate on the millimeter, micro, and nano scales in vivo to acquire internal information.
2. An information system that structures the in vivo information obtained by remotely operating a group of small CAs, expands it to spatiotemporal in-body environmental information which will grow and evolve with the individual, and presents it.

In this project, we will first target the digestive system. The digestive system is not only important for maintaining health, but also because it is a biological environment that encompasses millimeter, micro, and nanoscales, and can reach diseased areas, organs, and cells via the digestive tract from the mouth or anus. The small CA group targeting the digestive system has the following four functions.

- Measure (temperature, pH, etc.)
- Deliver (medicine, useful bacteria, etc.)
- Remove (cells/tissues, tumors, etc.)
- Take out (cells, bacterial flora, secretions, etc.)

Appropriate functional design is required according to given missions. The shapes of in-body CA include capsule type, helical/ring type, and stent type. In addition, variations of remote control can be classified into "distributed remote control"(Distributed CA) and "cooperative remote control"(Cooperated CA). Distributed CA has a function to measure the environmental conditions in vivo by itself, and multiple bodies can distribute and measure spatiotemporal in-body environmental information at different positions.

Cooperative CA, on the other hand, allows multiple small CAs to cooperate with each other to collect cells and tissues, make judgments and treatments necessary for biomedical tissue diagnosis, and measure spatiotemporal in-body environmental information.



3. Future plans

This project aims to achieve the following:

1. Establishment of a health monitoring method to grasp the health condition in detail.
2. Establishment of technology that allows anyone to be watched over by doctors and specialists anytime, anywhere.
3. Establishment of technology to expand knowledge with in-body CA and create safety, security, and comfort.