

# Co-evolution of Human and AI-Robots to Expand Science Frontiers

## Project manager

(selected in 2020)

## HARADA Kanako

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The University of Tokyo



## Leader's institution

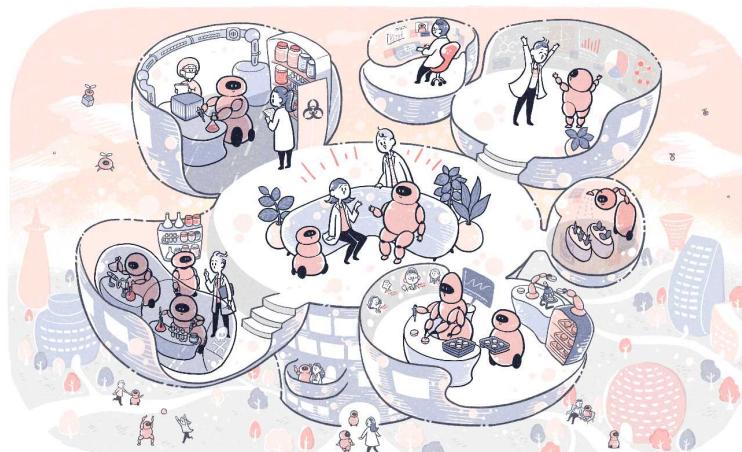
The University of Tokyo

## R&D institutions

Nagoya University, Kyoto University, Hokkaido University, The University of Tokyo, Tokyo, Tohoku University, Kyusyu University, Medical and Dental University

## Project Summary

This project aims to develop AI-robots conducting scientific experiments in a challenging environment (e.g. in a hazardous atmosphere, or in a micro-scale setup), while interacting with scientists as a peer scientist. AI-robots and scientists will change their mutual interactions and do tries-and-errors together to handle objects or work in environments that they have never experienced with. The proposed concept will realize the discovery of scientific principles and solutions by AI-Robots in the science fields by 2050.



Vision of AI-robot scientists in 2050

## Milestone for 2030

The project will develop AI-robots that estimate and reflect the intentions and thoughts of scientists based on their past activities to autonomously perform scientific experiments that could not be done by human scientists alone.

## Milestone for 2025

The project will develop AI-robots that automatically interpret a large set of experimental results and propose hypotheses to scientists that humans would not be able to come up with, enabling scientists to formulate new strategies to perform scientific experiments that could not be done by human scientists alone.

## Research topics

**AI-robot scientists that autonomously explore science and work as a peer scientist** require **the body** whose physical capabilities are beyond those of human scientists in terms of accuracy, precision, and dexterity, and **the brain** whose processing capabilities are beyond those of human scientists in terms of the data size and data modalities to handle, and the body and brain need to be integrated so that the AI-robots scientists can autonomously explore science without being pre-programmed by human scientists. Laboratory automation is to automatically conduct pre-programmed experiments, and thus the time required for scientific discovery can be shortened, but the quality of discovery would be the same. The AI-robot scientists with degrees of autonomy are to enable experiments previously thought impossible and alter the quality of scientific discovery by compensating human scientists. The project involves researchers in many disciplines, including both engineers and scientists. The collaborating scientists use prototypes for **scientific applications** while giving feedback to engineers.

### <Topics>

#### (1) Body of the AI-robot Scientists

Robotic platforms and micro-robotic tools will be developed to enable accurate, precise, and dexterous manipulation beyond the physical capabilities of human scientists.

#### (2) Brain of the AI-robot Scientists

**Science AI** to interpret experimental results and propose hypotheses, **Robot AI** to interpret experimental manipulation and propose manipulation strategies, and **mathematical foundations** to abstract knowledge and skills will be developed.

#### (3) Scientific applications

Scientists will use prototypes of AI-robots to conduct experiments.

#### Mathematical foundations



NagoyaU  
Shogo  
TANIMURA



NagoyaU  
Yoshihiro  
MARUYAMA



HokkaidoU  
Takashi  
MATSUBARA

#### Science AI



NagoyaU  
Ichiro  
TAKEUCHI



NagoyaU  
Kensaku  
MORI



NagoyaU  
Ryohel  
SASANO



KyotoU  
Tadashi  
TANIGUCHI



UTokyo  
Kei  
OKADA

#### Robot Bodies



UTokyo  
Fumihito  
ARAI



UTokyo  
Kanako  
HARADA

#### Scientific Applications



TohokuU  
Nobuyuki  
UOZUMI



KyushuU  
Miko  
ARISAWA



NagoyaU  
Yoshiatsu  
SATO



TMDU  
Takanori  
TAKEBE