Goal3 Realization of AI robots that autonomously learn, adapt to their environment, evolve in intelligence and act alongside human beings, by 2050. 能 MOONSHOT

Collaborative AI robots for adaptation of diverse environments and innovation of infrastructure construction

## Project manager

(selected in 2020)

# NAGATANI Keiji

Project Professor, Graduate School of Engineering, The University of Tokyo



# Leader's institution University of Tsukuba

### R&D institutions

The University of Tokyo, Osaka University, Kyushu University, Tokyo Institute of Technology, Tohoku University, Nara Institute of Science and Technology, Seikei University, RIKEN, Yanmar Co., LTD., Kokusai Kogyo Co., Ltd., Kumagai Gumi Co., LTD., Chiba Institute of Technology

# Summary of the project

We will conduct research and development of "collaborative AI robots" that can respond flexibly to different situations and perform tasks in difficult environments such as disaster sites. This technology will also be useful in the construction and maintenance of infrastructure on the ground.

# Milestone by year 2030

Aiming to mitigate natural disasters (river channel blockage), we will develop a multi-unit cooperative AI robot system that can respond flexibly to different situations than expected.

## Milestone by year 2025

We will develop a prototype of a system of multiple cooperative AI robots that can respond flexibly to different situations than expected for the purpose of mitigating natural disasters (river channel blockage).

### Project structure

The major goal of this R&D project is "realization of infrastructure construction adapted to various environments by cooperative AI robot systems. To realize this major goal, we have set up three research and development items: "1. an AI robot system to innovate earthwork" (hardware), "2. a dynamic cooperative system for multiple robots" (AI to control multiple robots), and "3. a sensor pod system for a bird's eye view of the work site" (AI to evaluate sensing technology and the environment), and have conducted research and development in parallel (Figure 1). After 2024, we will focus on robot systems that can respond to natural disasters (especially river channel blockage disasters), promote technological innovation, and aim for system integration of these technologies (Figure 2).



Figure 1: Item structure and members (2020-2023)

System Integration (SI) of Disaster Response Technology for River-Channel Blockage	
5: System integration (SI) of emergency investigation for river channel blockage	6: System integration (SI) of emergency restoration work for river channel blockage
5-1: SI of Remote Information Gathering Technology for a River-Channel Blockage (Kokusai Kogyo Co., Ltd.)	6-1: SI of Emergency Restoration Work Technology for a River-Channel Blockage (KUMAGAI GUMI CO., LTD.)
5-2: SI of water level sensors for a River-Channel Blockage (The Univ. of Tokyo)	6-2: Realization of high-precision work for construction robot to enable on-site adaptation for Emergency Restoration Work (Yanmar CO., LTD.)
5-3: Risk assessment of river channel blockage using environmental assessment AI (The Univ of Tokyo/RIKEN)	6-3: R&D of Ground Strength Survey for determining the entry of construction machinery into disaster site (Tohoku Univ.)
5-4: SI of Topographic Displacement sensors for a River- Channel Blockage (Chiba Inst. of Tech.)	6-4: Development of sensor-pods to support emergency restoration work for a river channel blockage (Kurazume-Lab, Kyushu Univ.)
7: Technologies supporting emergency restoration work for river channel blockage	
7-1. Evaluation Methodology for Robotic-Earthwork Systems (Mitani-Lab, Kyushu Univ.)	7-4: Machine Learning for Advanced-Ground- Excavation for Excavators (Nara Inst. of Sci. & Tech.)
7-2. Robotic technology for Earthwork Innovation based on open-design concept (Osaka Univ.)	7-5: Work-Distributed Excavation Technology with Multiple Small Construction Robots (Seikei Univ.)
7-3. Development of powerful & soft-actuation technology for sensor fixation in a disaster environment (Tokyo Institute of Technology)	7-6: Dynamic Cooperation Technology for Multiple Small Construction Robots (The Univ. of Tokyo)
	7-7: A robot hand with flexible handling for use with construction robots (ETH Zurich)

Figure 2: Item structure and members (2024-)



Here begins our new MIRA