



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

School of Engineering
The university of Tokyo

Keiji Nagatani

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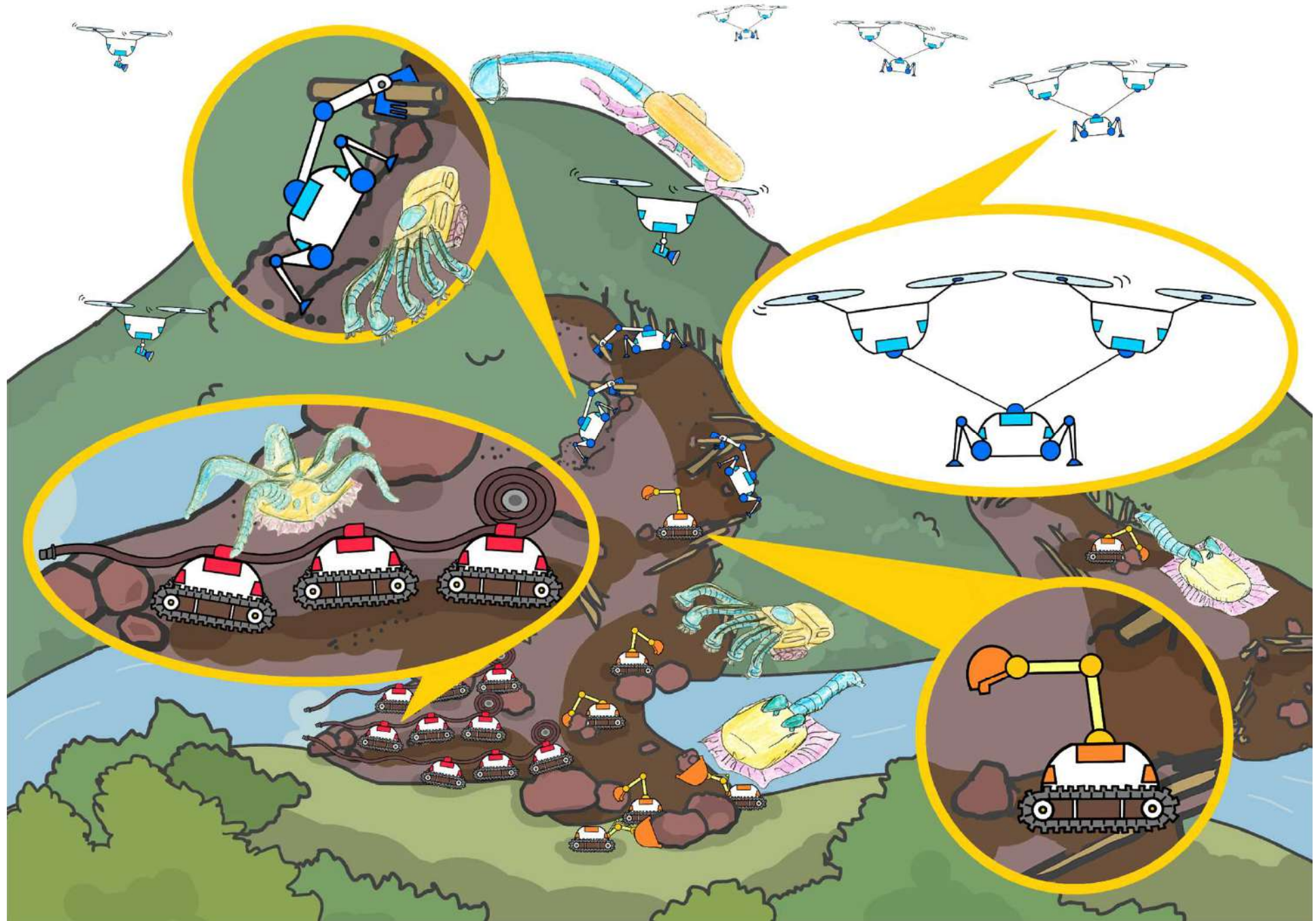
Technologies expected by society in 2050

- **Natural Disasters Response Caused by Global Warming:**
 - Emergency Response for Natural Disasters to Minimize Damage. & Establishment of an international position as a country that promotes disaster mitigation and recovery.
- **Establishment of base for manned exploration on the Moon:**
 - Infrastructure construction technology for building a base for manned exploration. & To be a leading country in international cooperation for lunar development.



A field robot system
that adapts to diverse environments
and builds infrastructure

Image of emergency response using multiple field robots at a natural disaster site



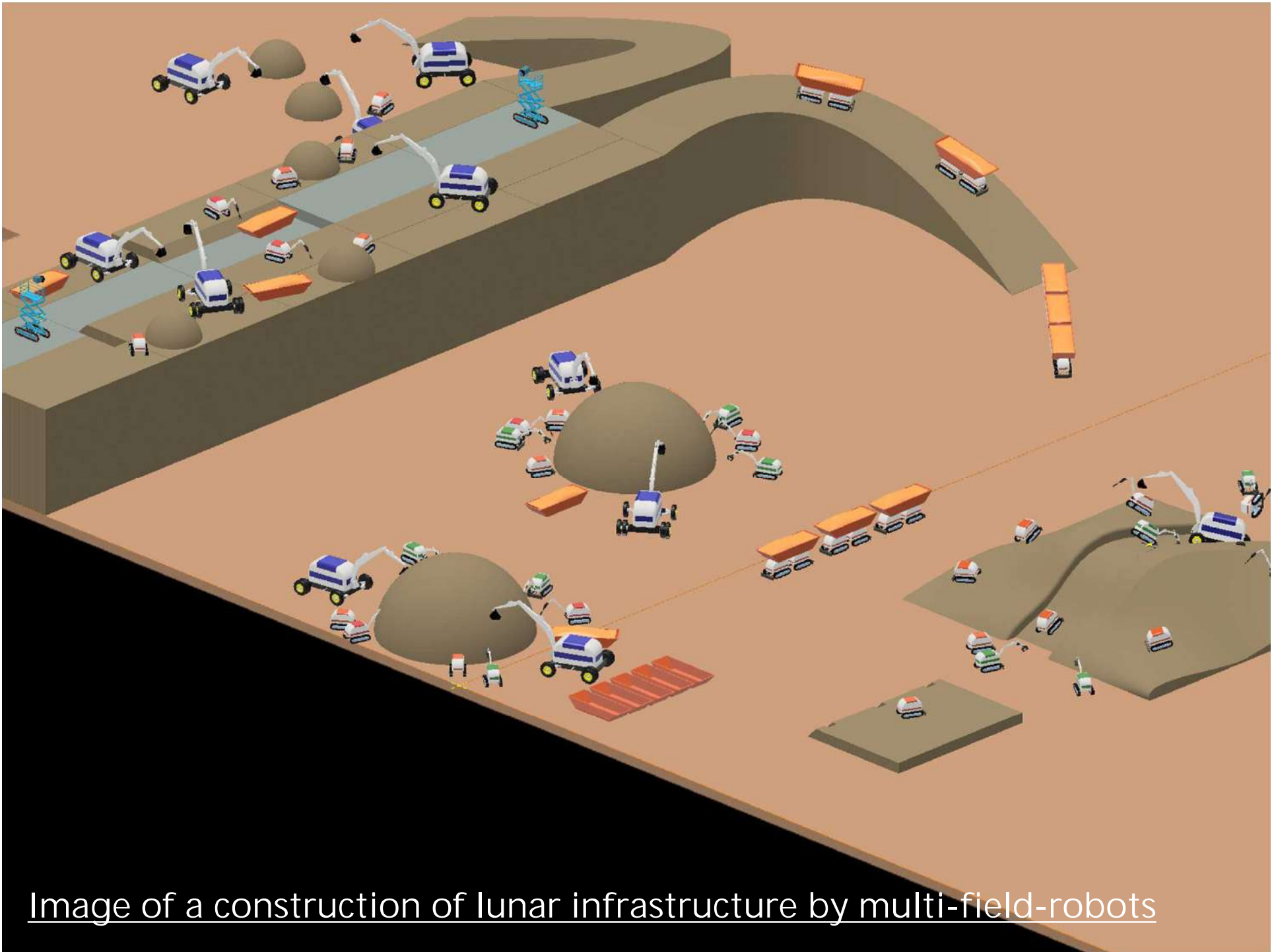


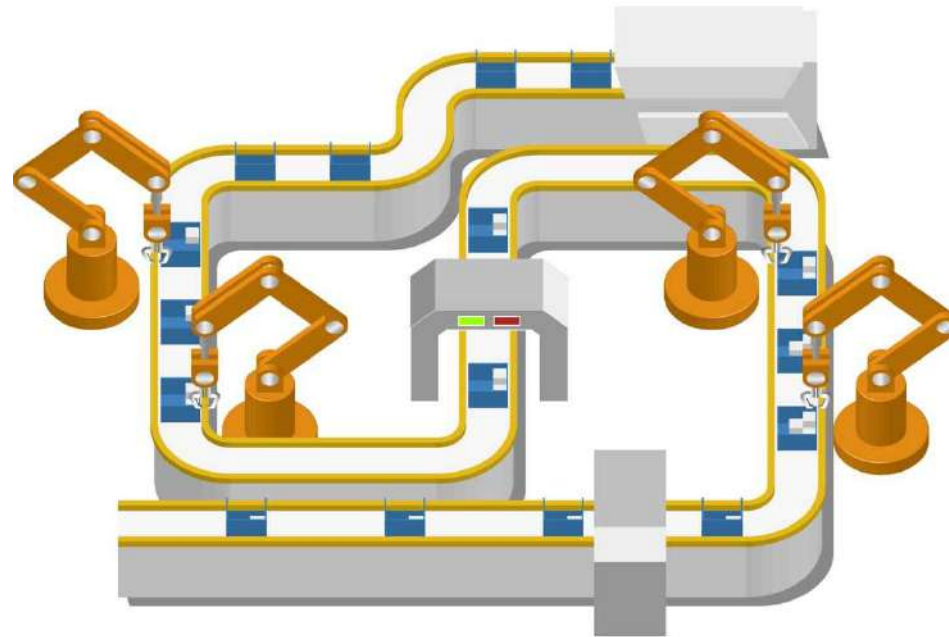
Image of a construction of lunar infrastructure by multi-field-robots

Difficulties in designing field robot systems

Current mainstream approaches:

← Closed design

- Designing robot hardware for a **given situation**
- Designing robot software for a **given situation**
- Optimal motion planning according to the **situation**
- Robust execution of the plan based on sensing data



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Field robots: failure example of current mainstream approaches

- Designing robot hardware for **ALL possible situations** (increasing in size)
- Designing robot software for **ALL possible situations** (divergence of assumptions)
- Optimal motion planning according to **various situations**
(understanding the situation in an ever-changing environment is the key...)
- Robust execution of the plan based on sensing data (sensing limitation)



← Failure of closed design

Difficulties in designing a field robot system

Problem of target environment:

Boundary conditions for the environment cannot be predicted in advance at the design stage (the **unknown of the environment** is very large).

→ The design problem is not closed. (It's a "**bad-setup-problem.**")

Design Issues for Disaster Response

- The time, place, and scale of the disaster cannot be determined.
- It is difficult to grasp the situation because of unstable ground and an ever-changing environment.
- The solution is not simple and there is no right answer to the procedure.

Design Issues for infra-development on the moon

- The environment is uncertain. In particular, there is a lack of knowledge about the ground.
- There is a high possibility of equipment failure and impossible to repair it.
- Information is limited available in remote areas and communication delays.



1. Flexible robots
that fits in with the
environment
(Body)



2. Environment-
evaluation-AI with
Many-Modality
(**measurement**)



3. Dynamic
Collaborative
Physical AI
(control)



"Closed design" + "Open design"

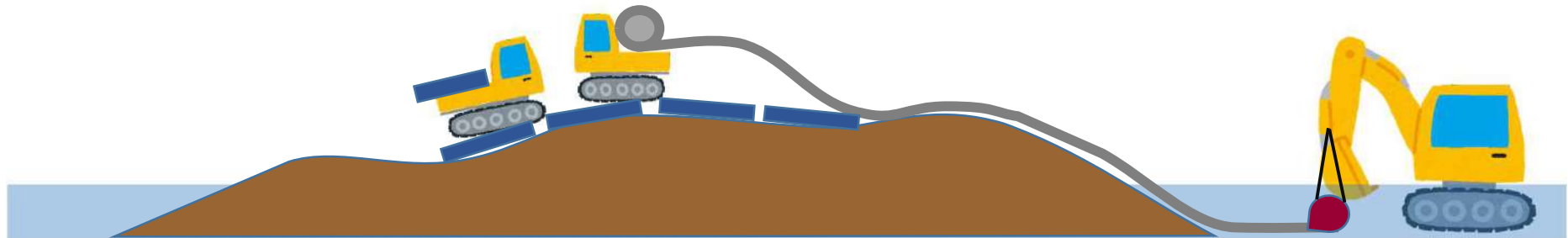
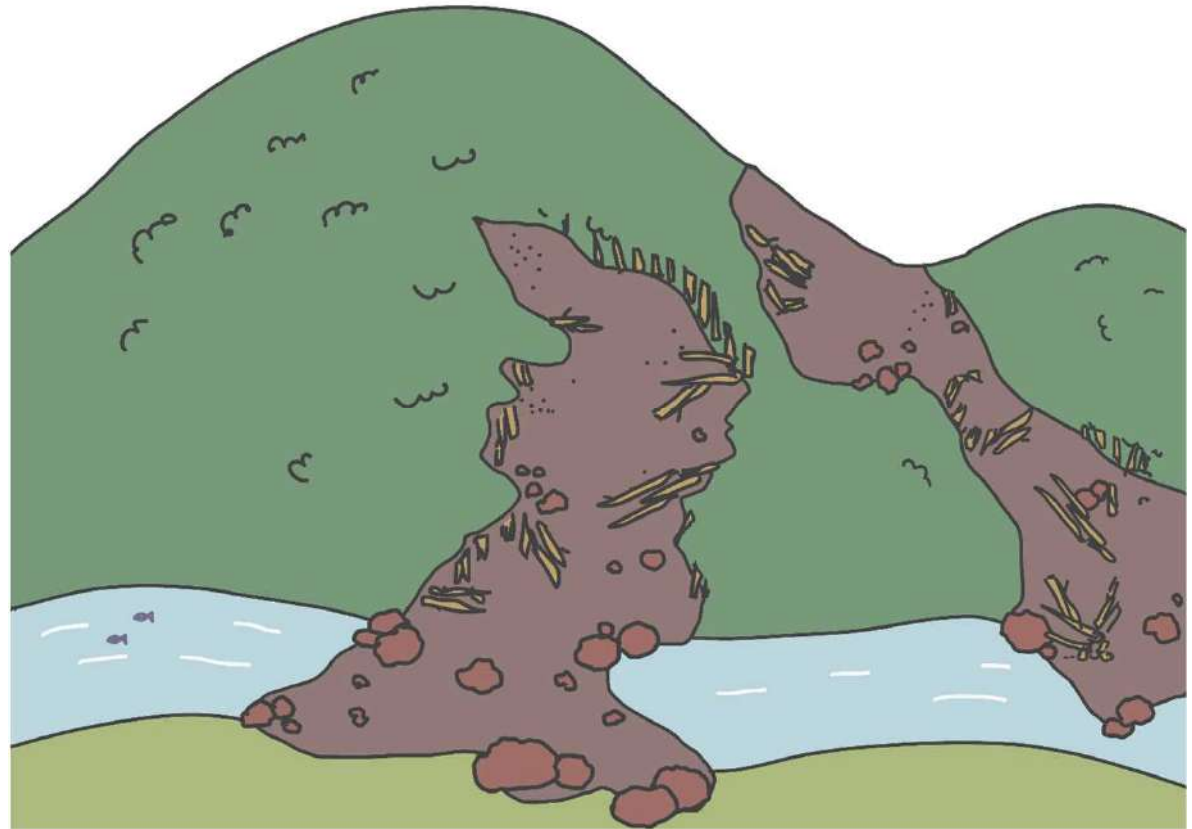
Introduced the concept of "open design," which has been critically lacking in conventional design methods.
(For both hardware and software)

Collaborative AI robot system
that adopts environments flexibly



Emergency response for Natural Disasters

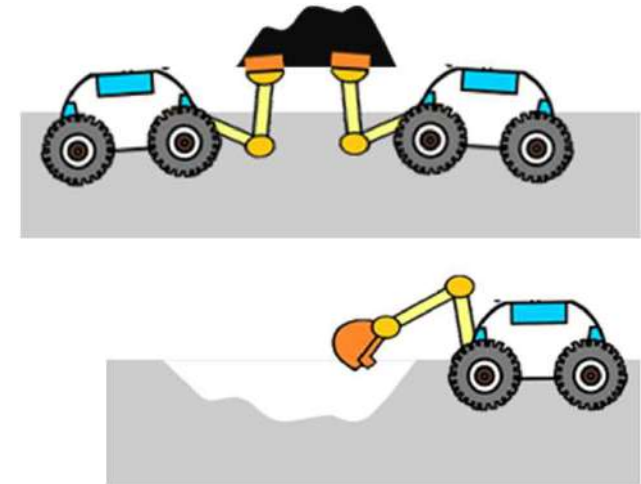
- information gathering
- risk assessment
- sediment transport
- drainage pump installation



Lunar Infrastructure Construction Technology

Landing base leveling by multiple robots

- Ground surveillance
- Ground preparation for uneven terrain (excavation, soil removal, burial)
- Compaction of the ground
- Installation of inflatable sandbags
- Rock moving and lifting



Landing base maintenance

- Marking of non-movable obstacles
- Installation of guiding light landmarks
- Construction of power and communication facilities



Process for project promotion

