THOTH

Beyond the world with AI

Technologies of THOTH

: Main Technologies for Robot AI

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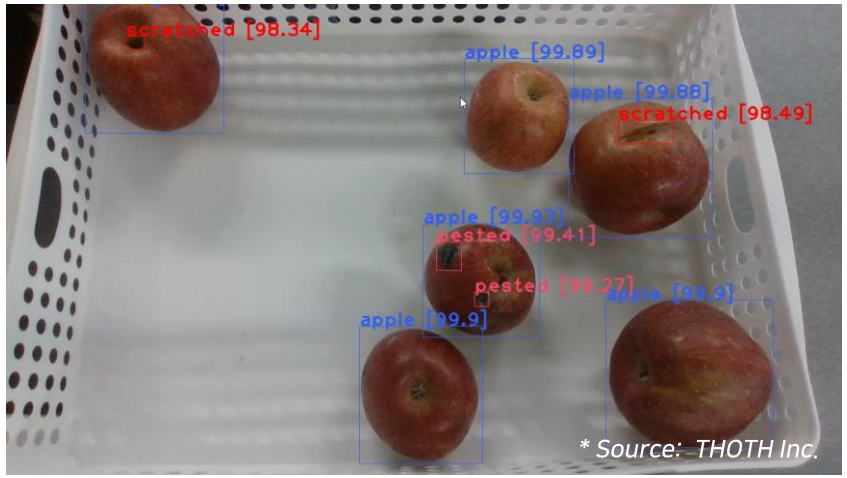
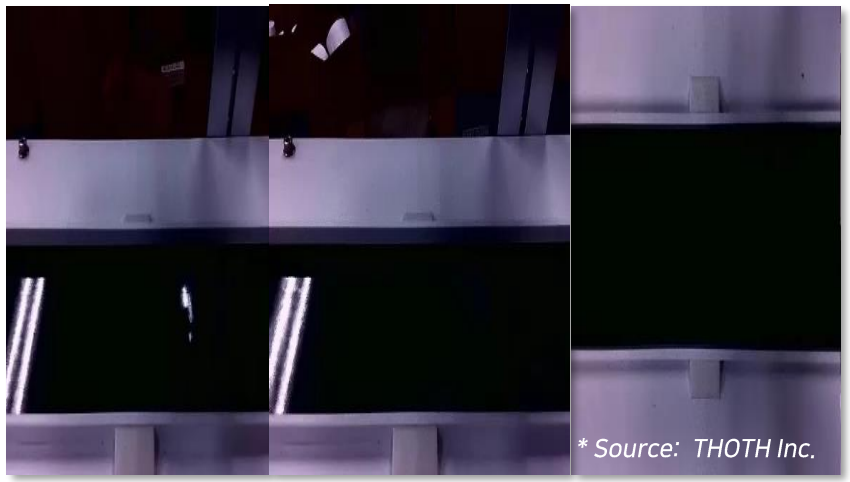
Representative examples of AI applications

- **Applications: inspection, monitoring, guidance, tracking, screening etc.**





Q1. How will you create or collect your training data?

Q2. Can you be sure your training data is good data?

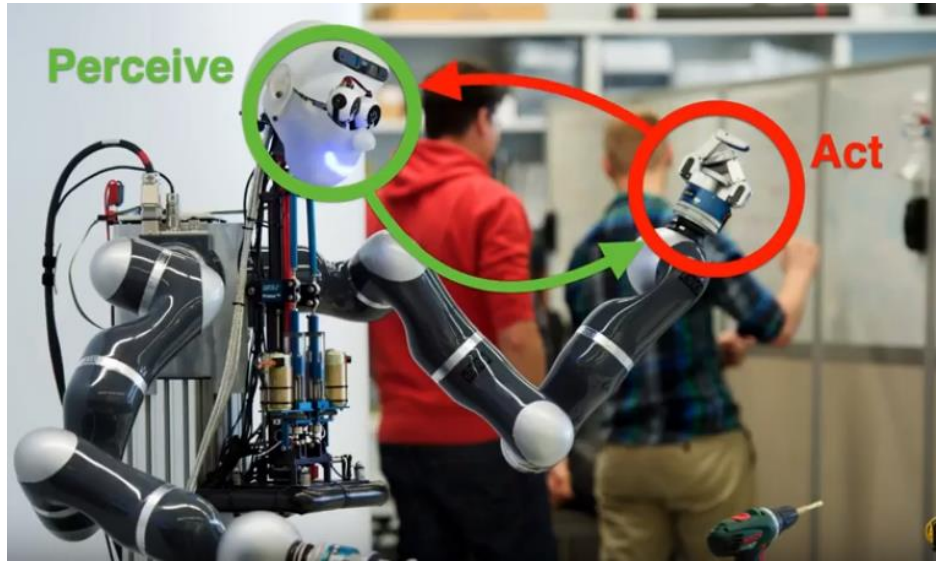
A1. Data synthesis is a trend these days.

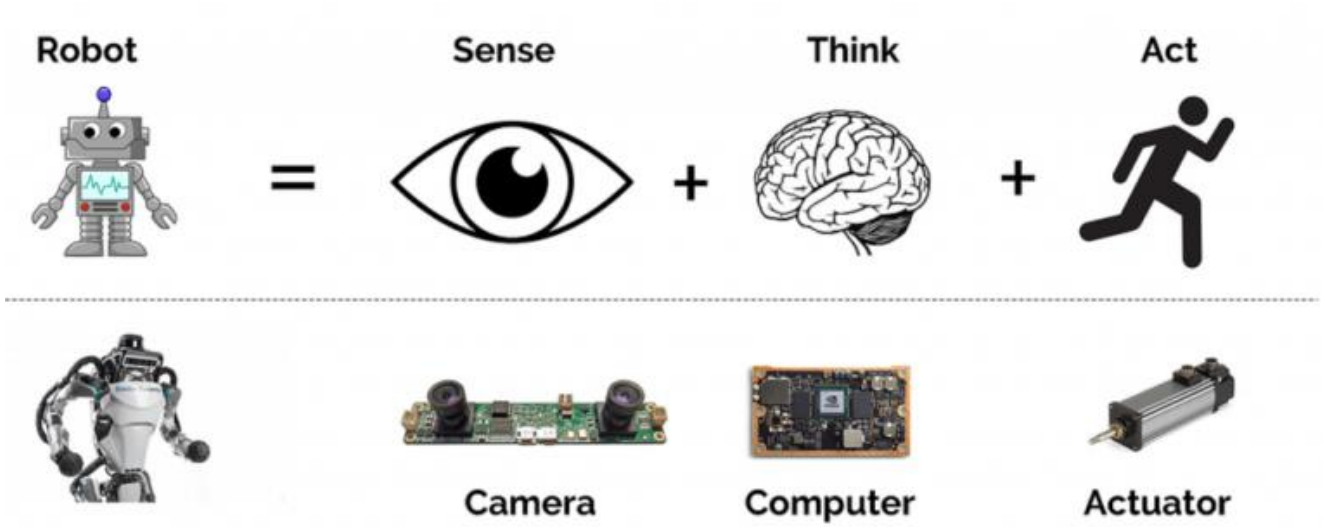
A2. Teachers(You) should select good data.

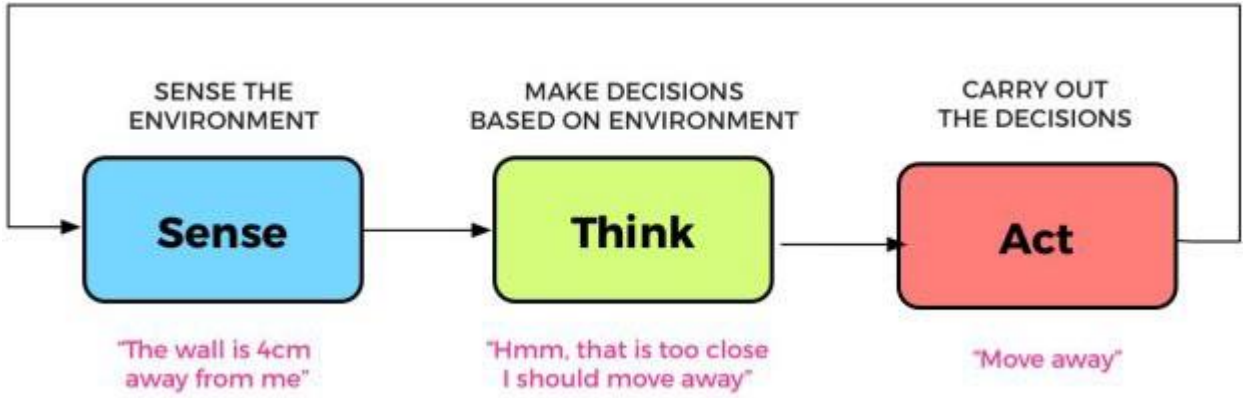
} **Know-how**

What is the difference between AI and Robot AI?

“Robot AI = AI + Body(Act) = Embodied AI”







How to make embodied AI?

- **Programming? vs. Learning?**

Programming

→ **Fixed or static environment**

→ **Repetitive behaviors**

Learning

→ **Dynamic environment**

→ **Behaviors w/ uncertainty**

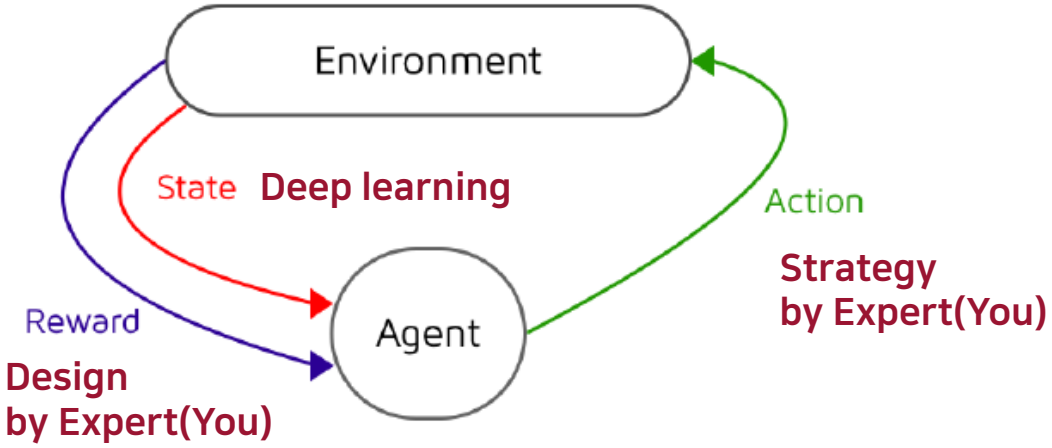
Q1. How will you create or collect your training data?

Q2. Can you be sure your training data is good data?

*** Training Embodied AI will be more difficult than training AI.

Let's make the robot itself.

Reinforcement Learning(RL)

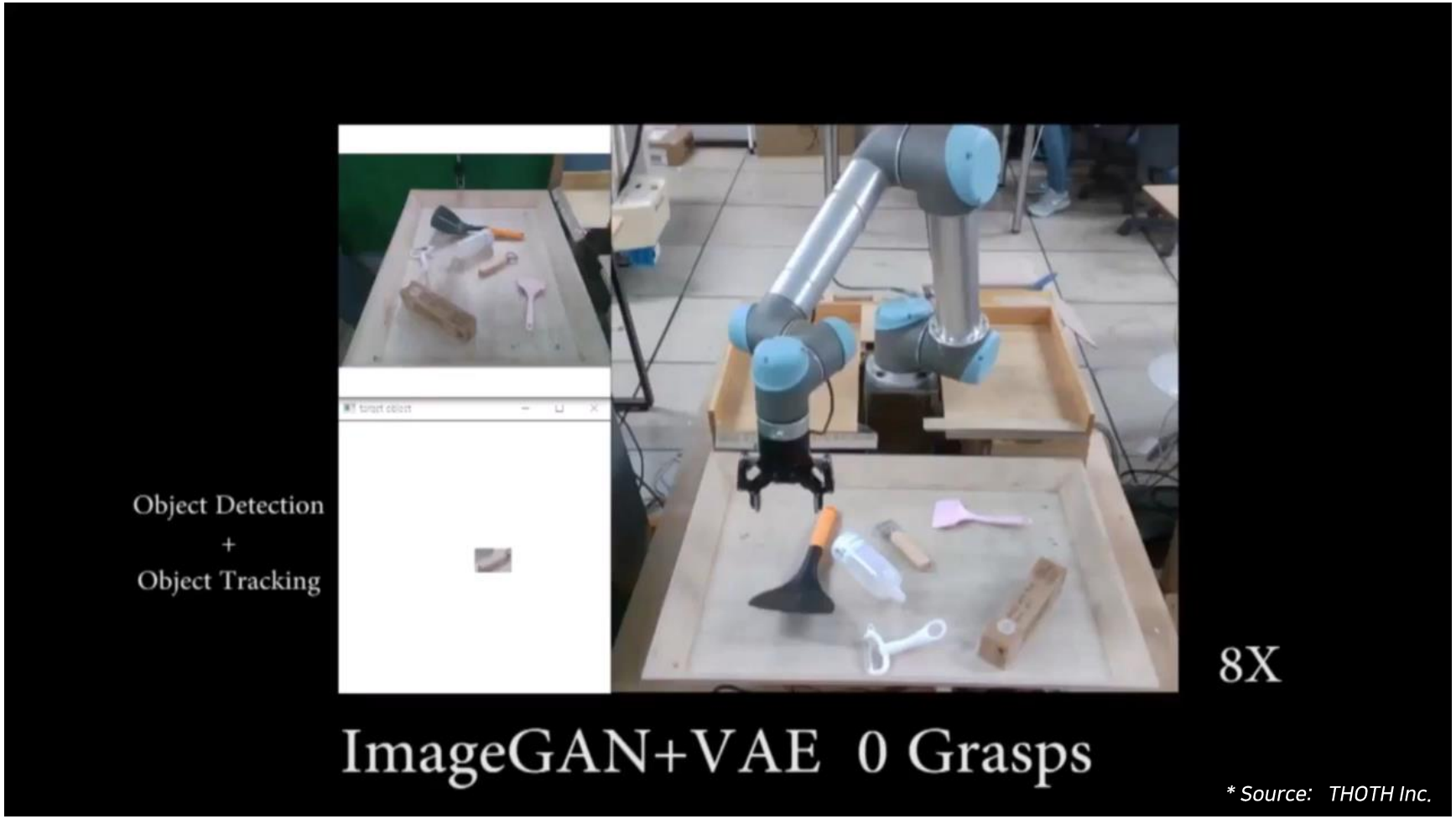


** Source: Hafner, Youtube*

Let the robot learn while making good training data by a specific strategy.

Examples of RL (1/3)

Finding the grasping point of an object for pick-and-place

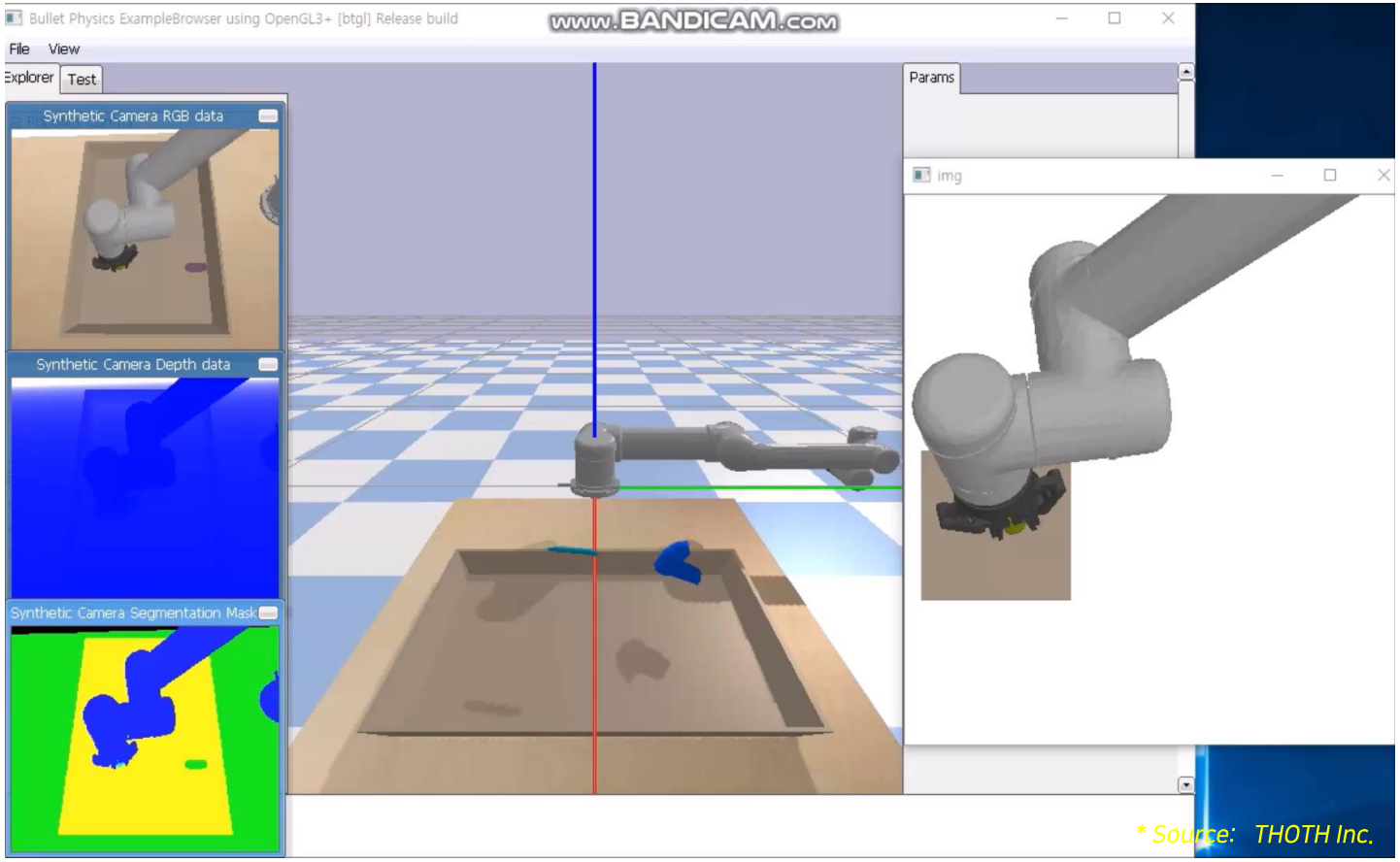


** Source: THOTH Inc.*

Hundreds to tens of thousands of iterations for learning (requires too much time and money)

Examples of RL (2/3)

Finding the grasping point of an object for pick-and-place



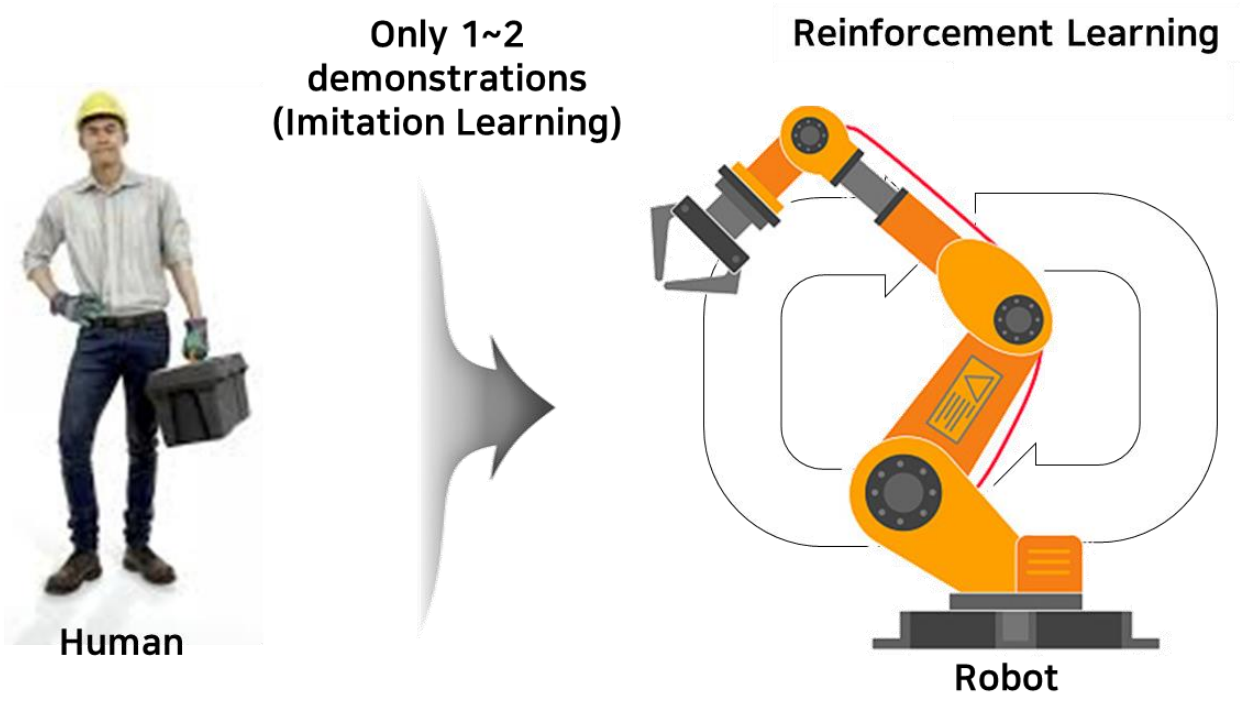
Simulation is used to reduce training costs and time.
The robot can learn by creating and collecting good data on its own.
However, it still requires too much time and money. (Because of random initialization and exploration)

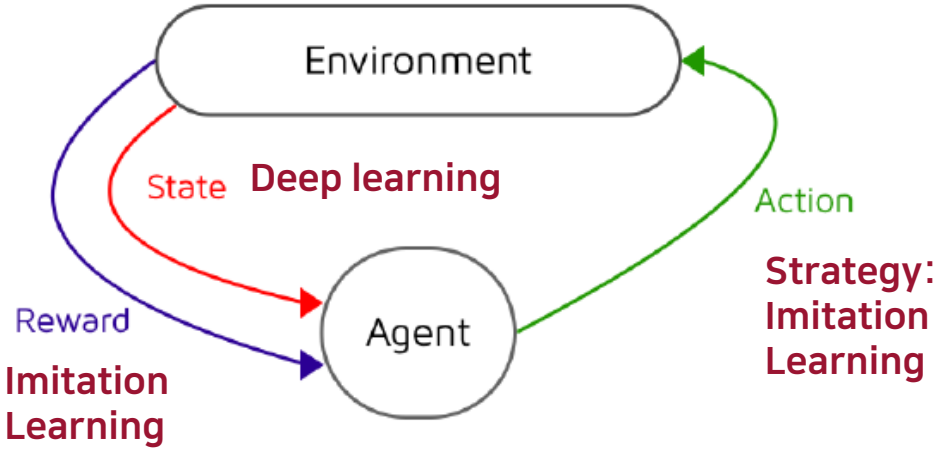
Examples of RL (3/3)

Finding the grasping point of an object for pick-and-place

** Source: THOTH Inc.*

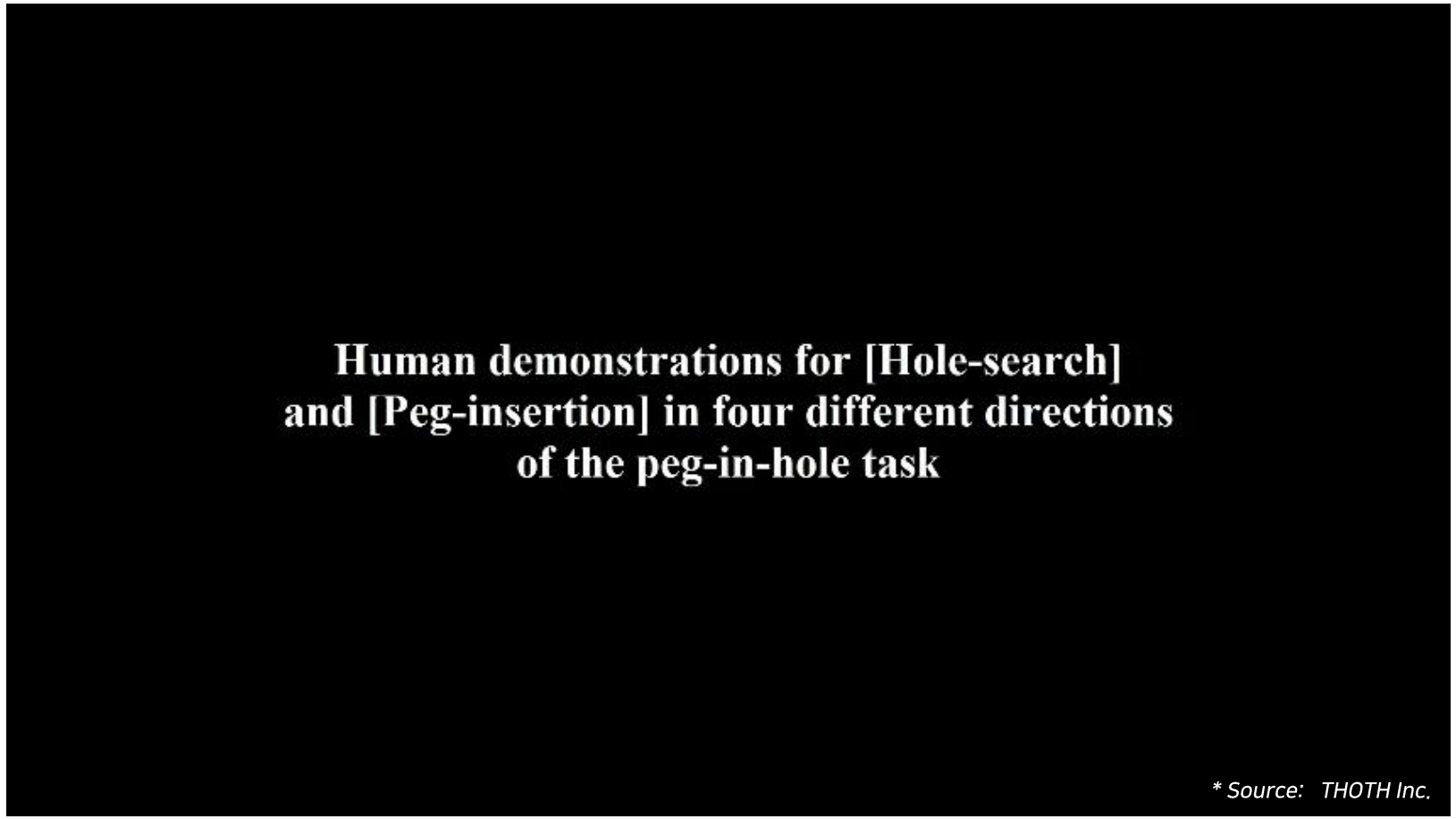
Time and cost of RL can be reduced through Imitation Learning (IL)





Examples of applications of IL + RL (1)

Pen-in-hole under the assumption that a vision error occurred



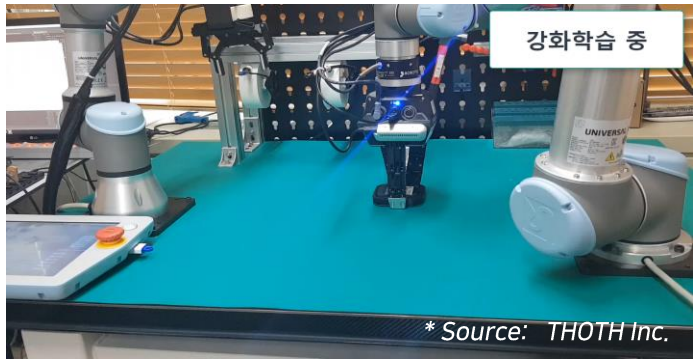
When a human provides demonstrations,
the robot can learn to suit itself by repeating dozens to hundreds of iterations.

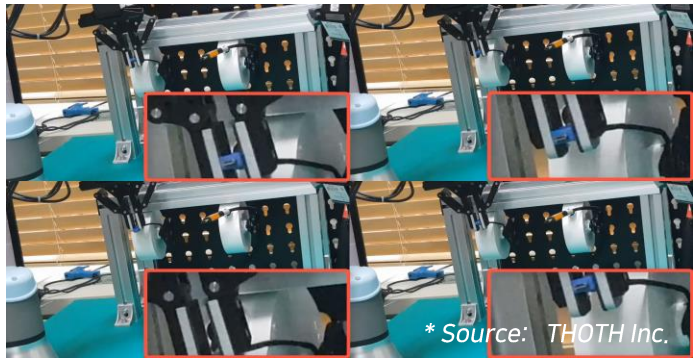
Examples of applications of IL + RL

Inserting connectors for set-top box performance testing

Demonstrations for IL

Learning by RL

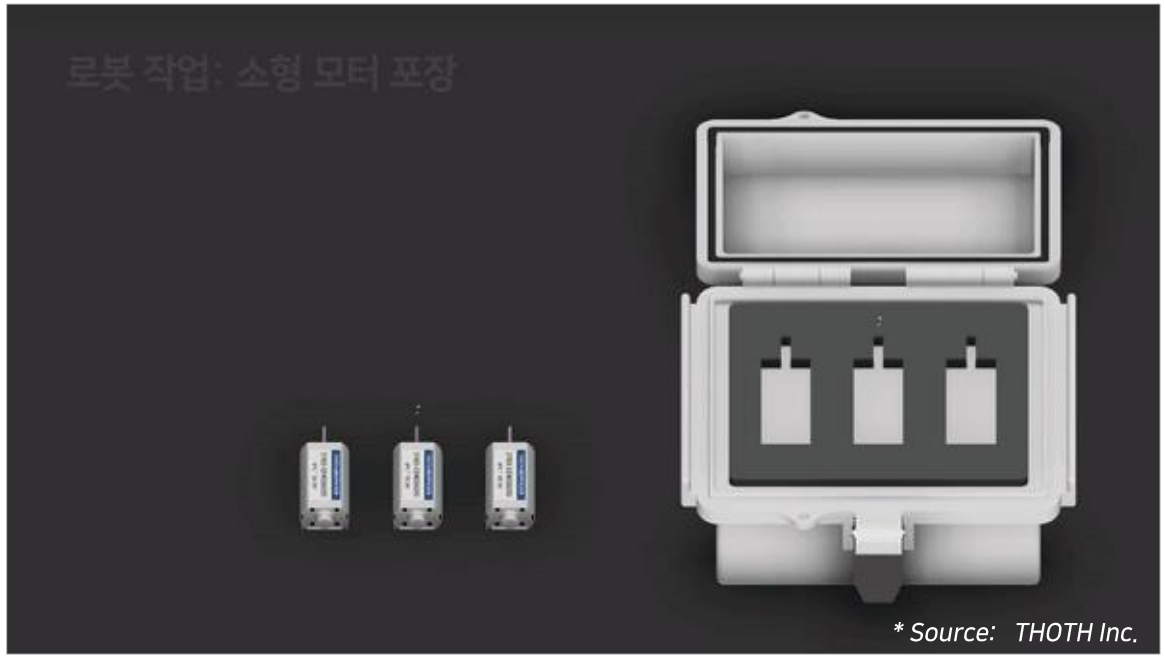




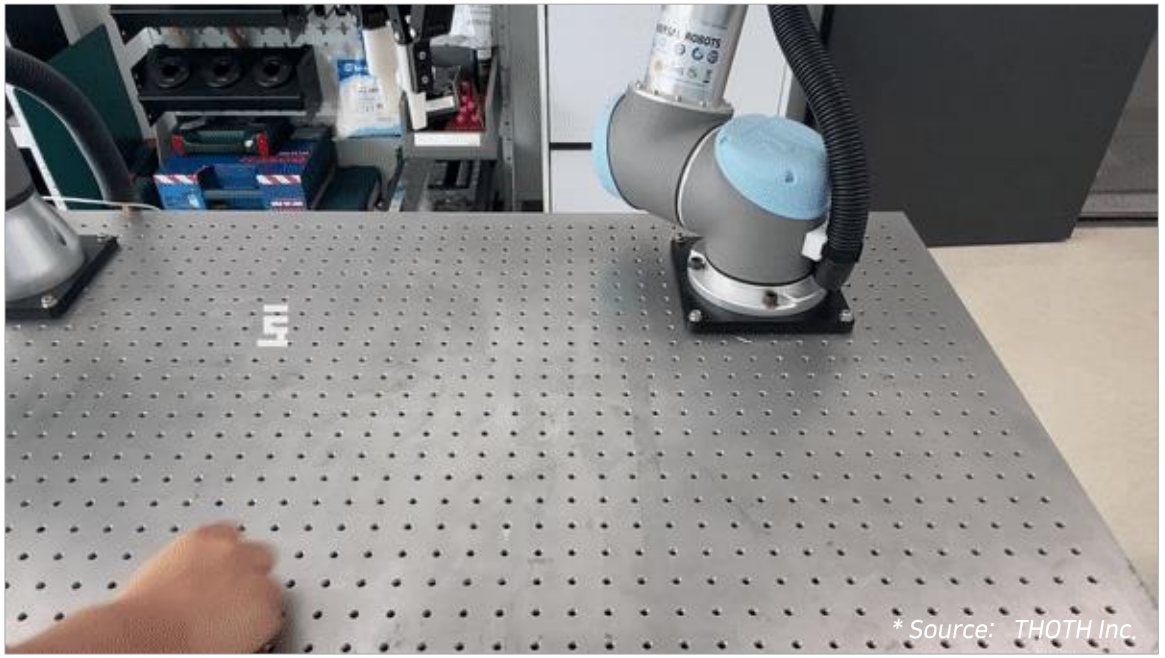
Planning after IL and RL

Examples of applications of IL + RL

Packing the motors in the motor case



* Source: THOTH Inc.



* Source: THOTH Inc.

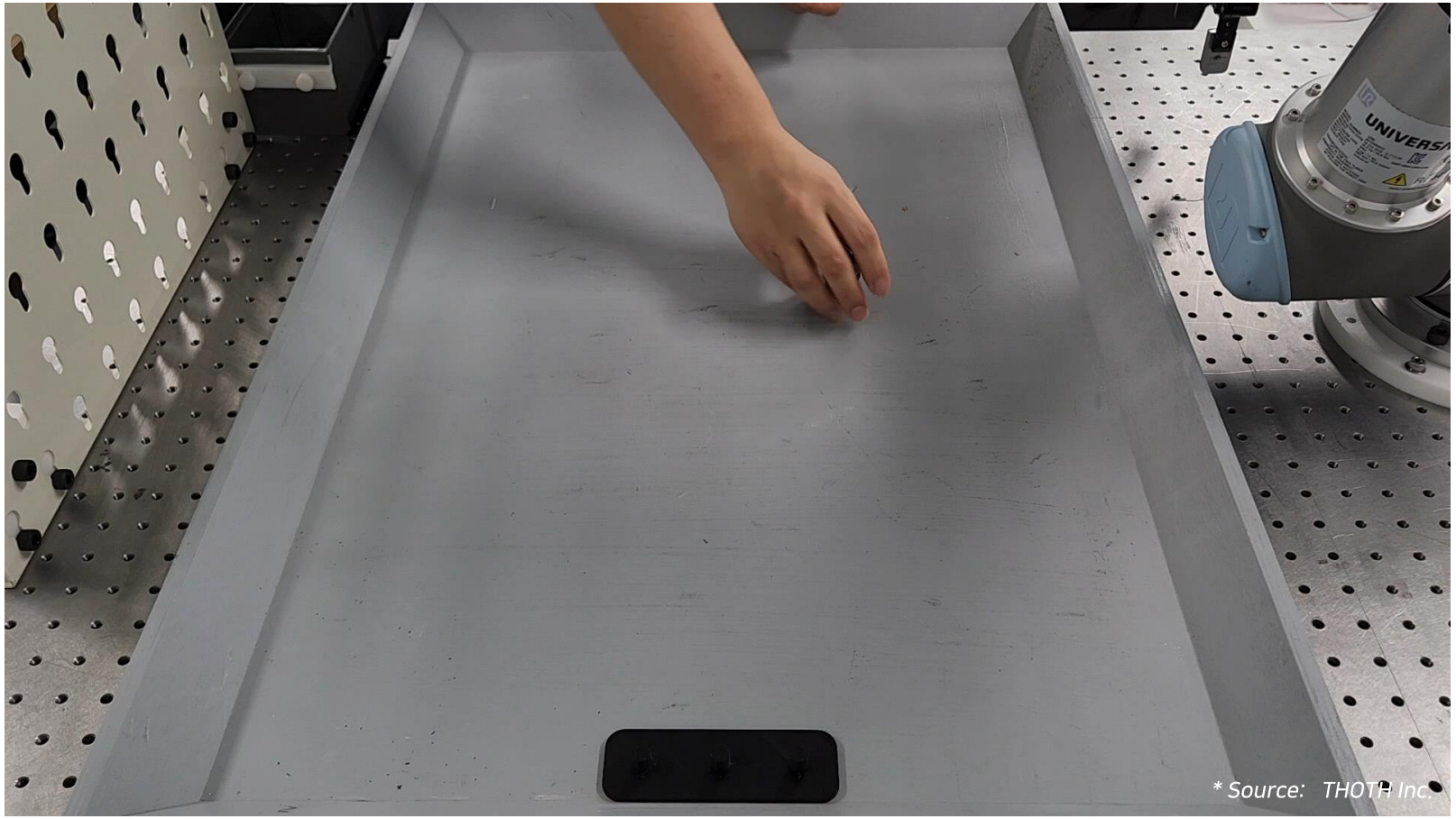
Examples of applications of IL + RL

Palletizing 2 types of boxes in multiple stages

** Source: THOTH Inc.*

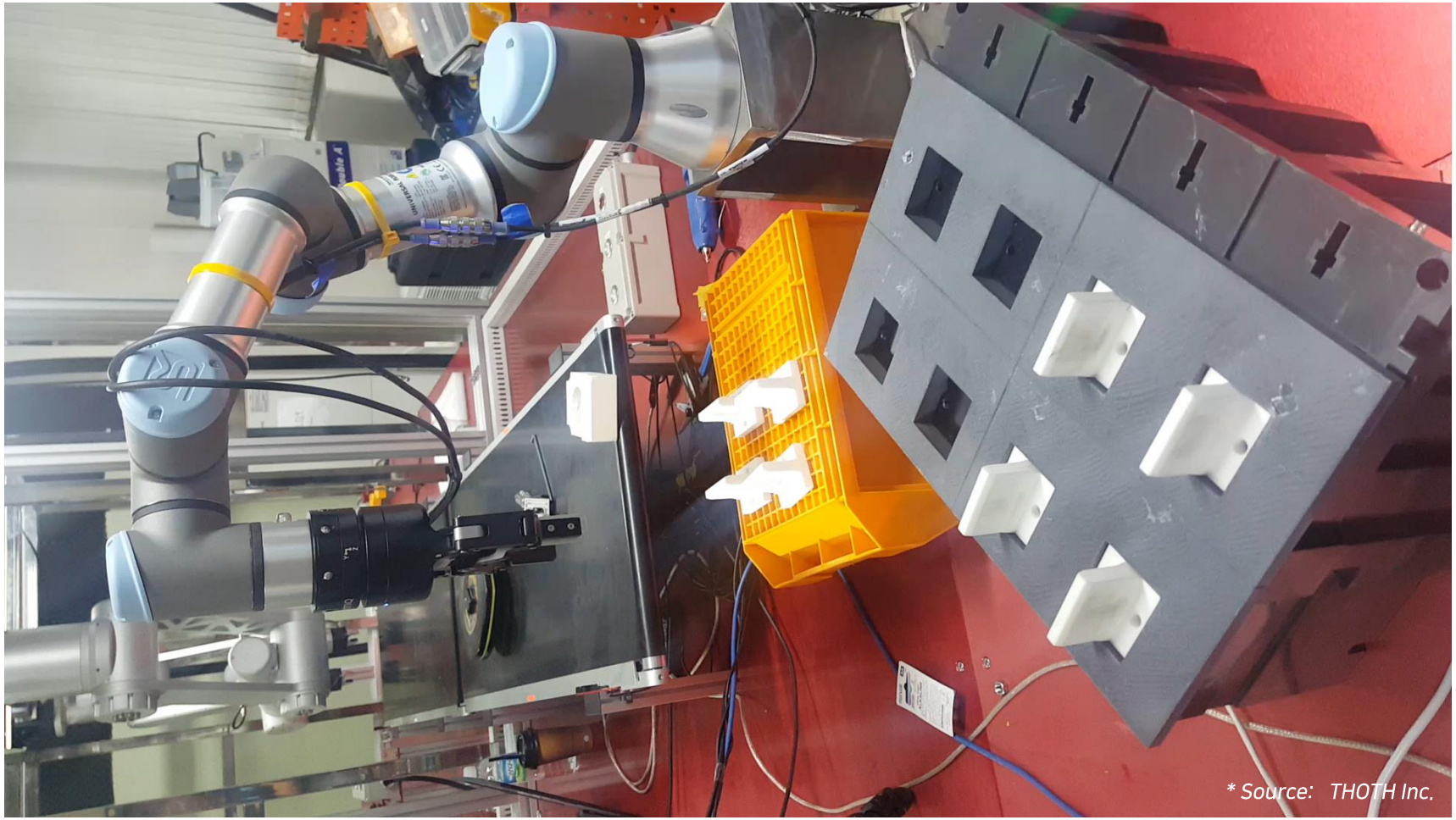
Examples of applications of IL + RL

Aligning car parts with orientation



Examples of applications of IL + RL

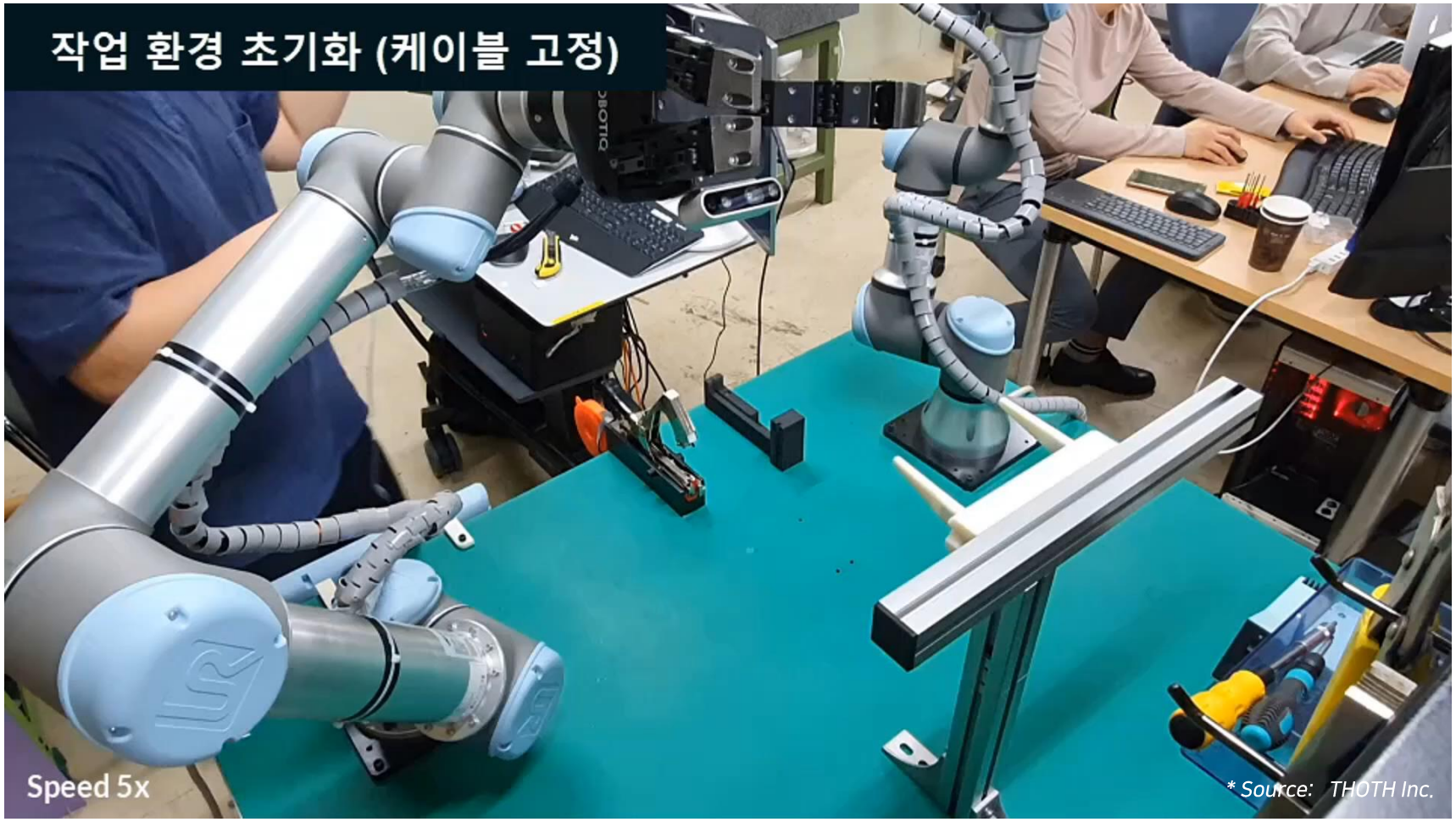
Inserting busbar components with a low-cost camera



* Source: THOTH Inc.

Examples of applications of IL + RL

Fasten with tape after tidying up electric wires



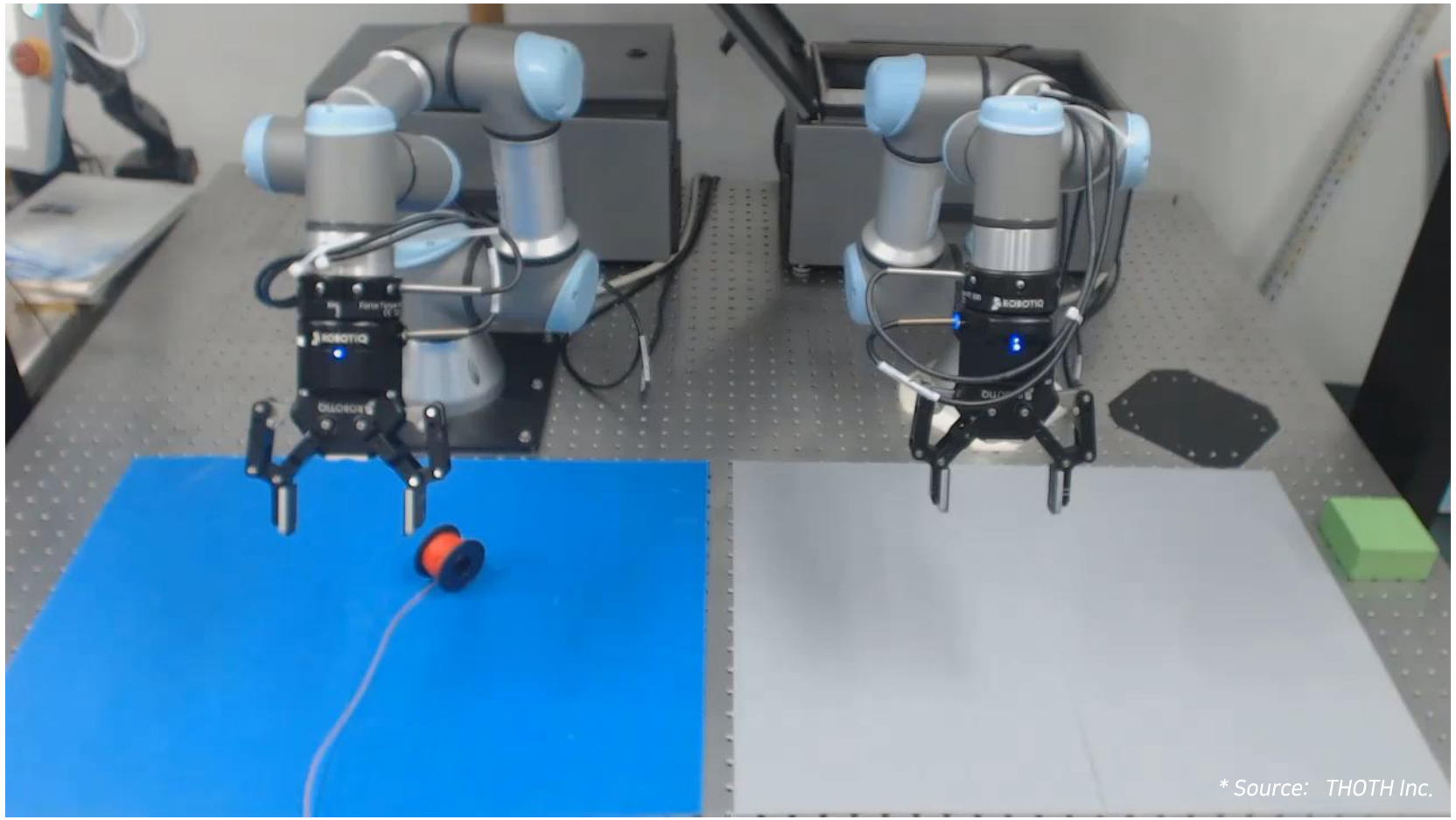
* Source: THOTH Inc.

Examples of applications of IL + RL

Inserting connectors for set-top box performance testing

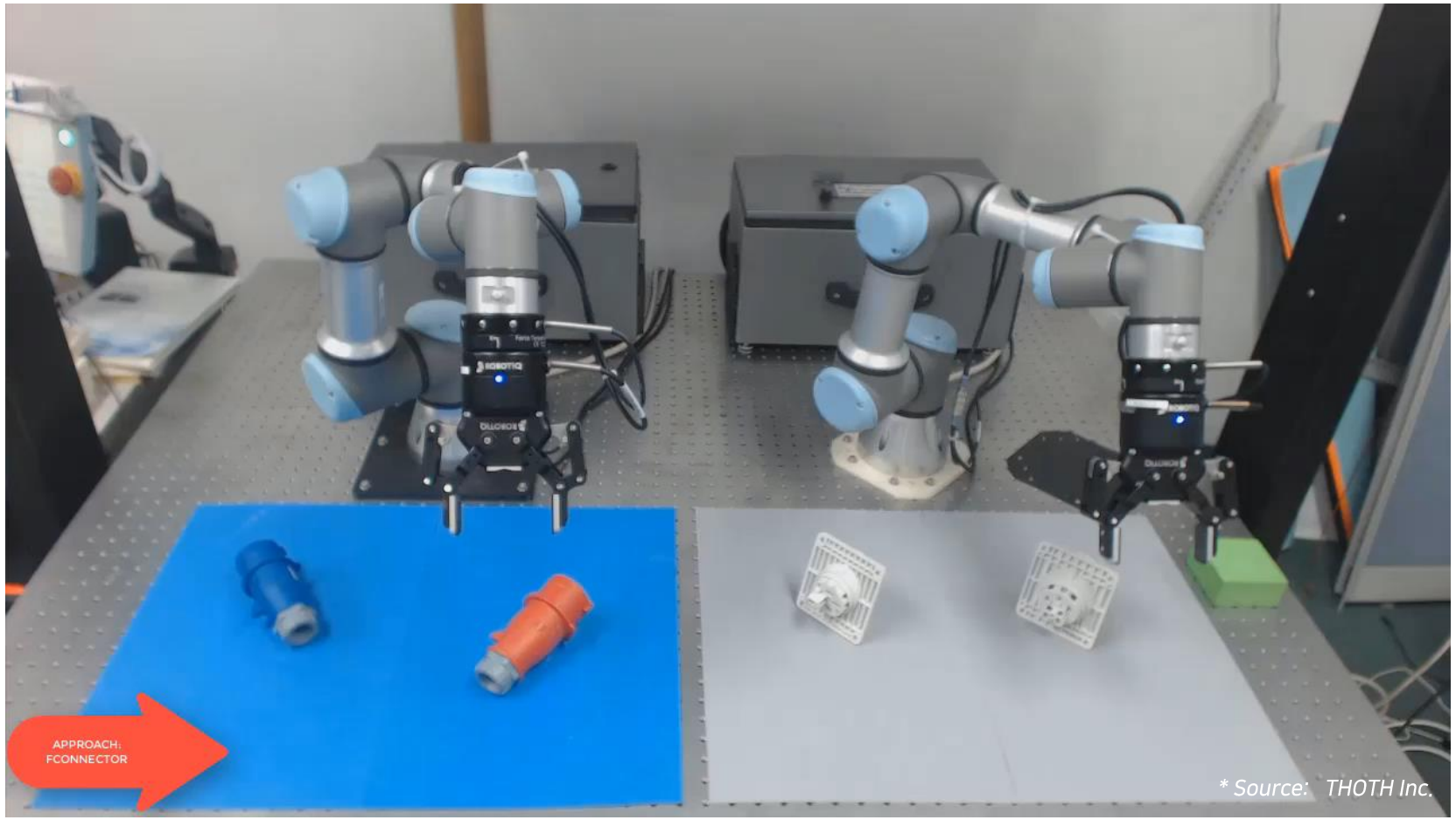
Examples of applications of IL + RL

Winding the cable on a pulley



Examples of applications of IL + RL

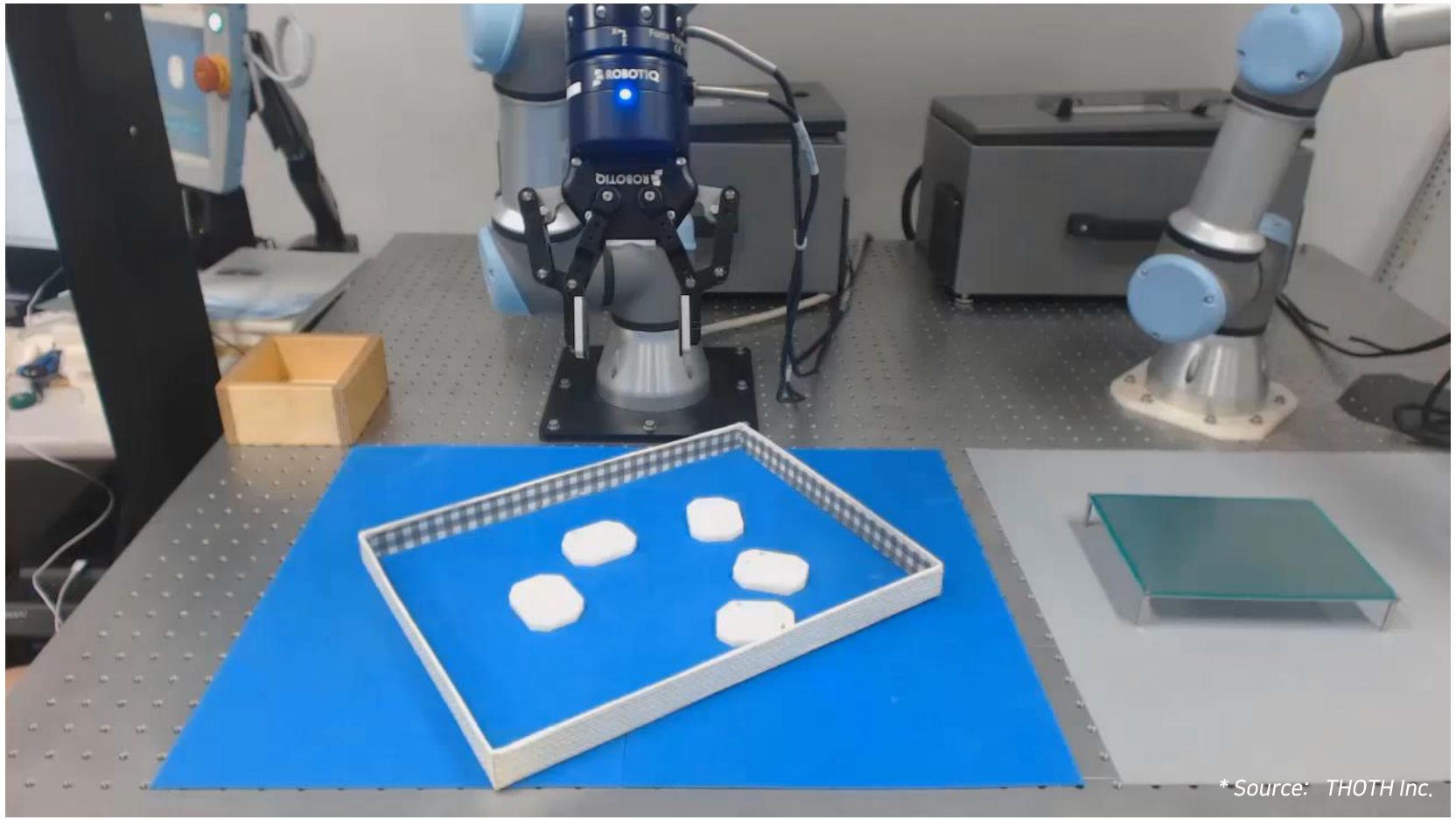
Combining two parts for checking the condition of plastic injection



* Source: THOTH Inc.

Examples of applications of IL + RL

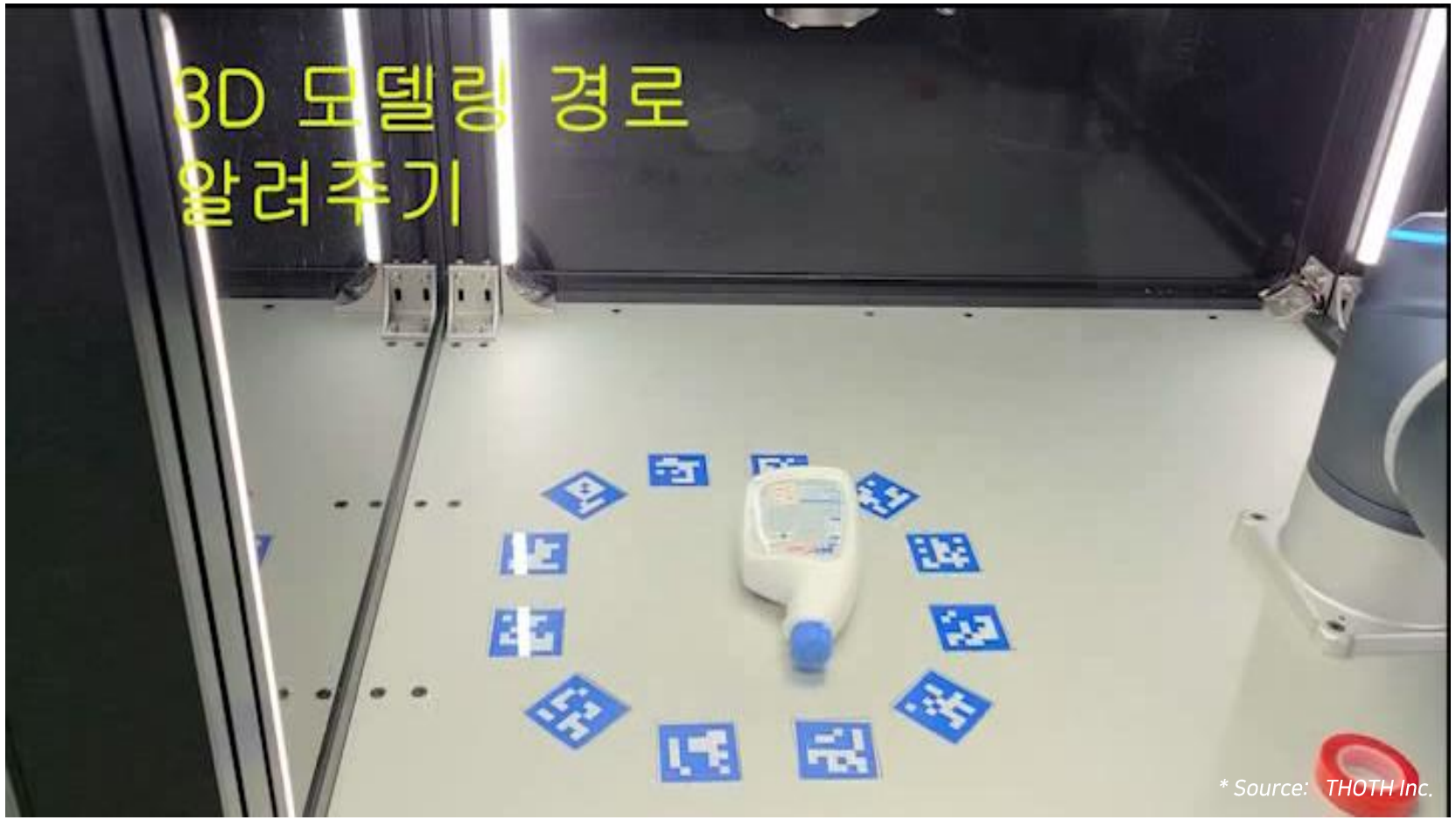
Pick-and-place with Robotiq camera



*Source: THOTH Inc.

Examples of applications of IL + RL

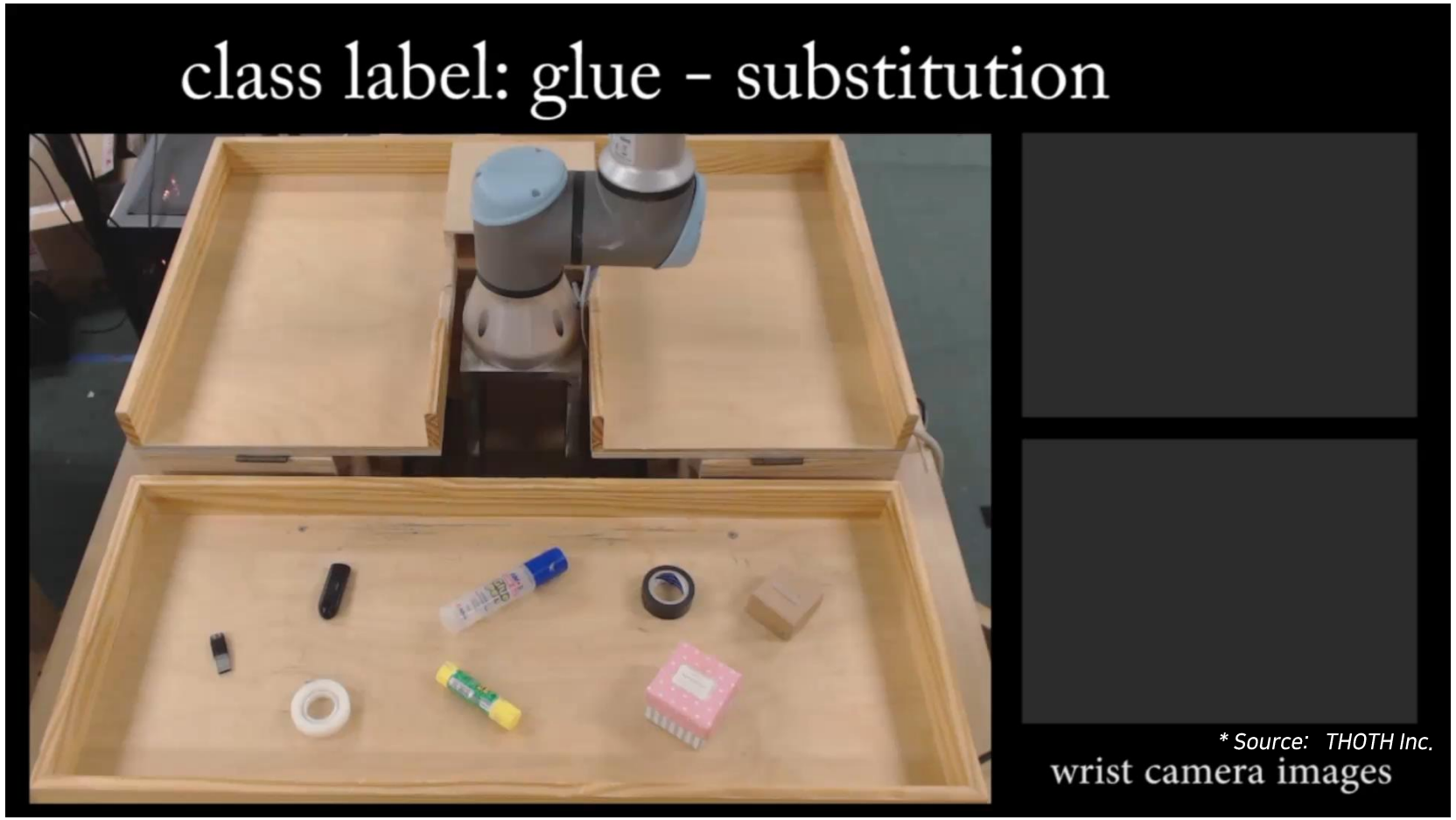
Predicting the 6D pose of an object using an RGB camera



* Source: THOTH Inc.

Examples of applications of IL + RL

Pick-and-place on first sight objects



Examples of applications of IL + RL

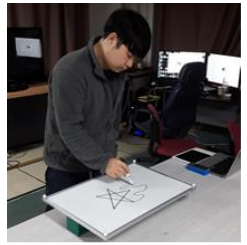
Assisting a worker by recognizing his working status (Proactive planning)

* Source: THOTH Inc.

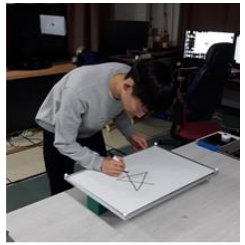
Should robots learn all human demonstrations?

Motion segmentation and selection based on motion complexity and motion significance

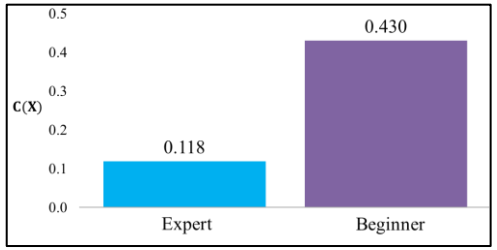
Motion Complexity

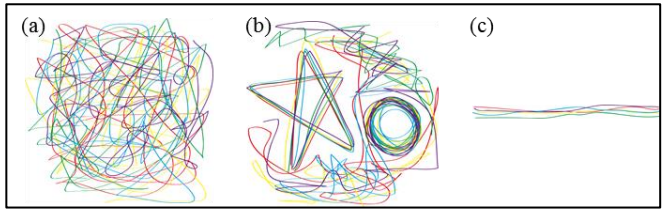


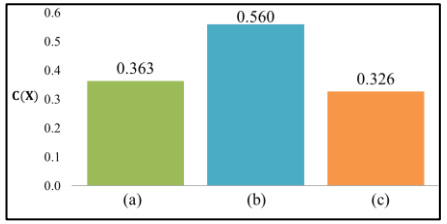
expert

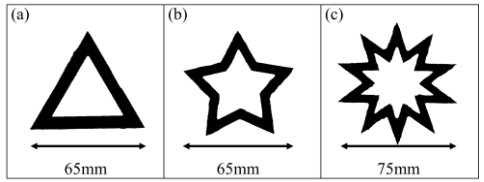


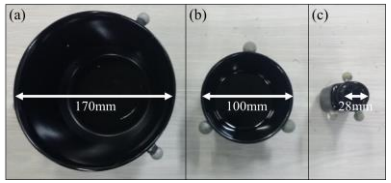
beginner

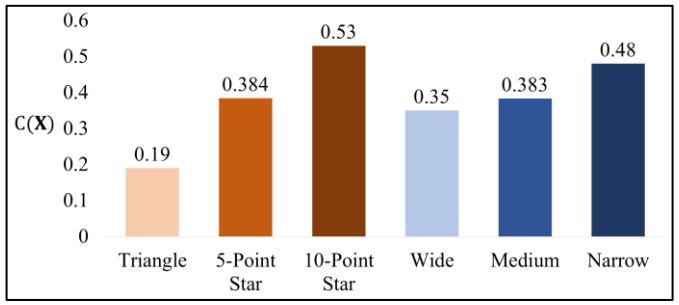




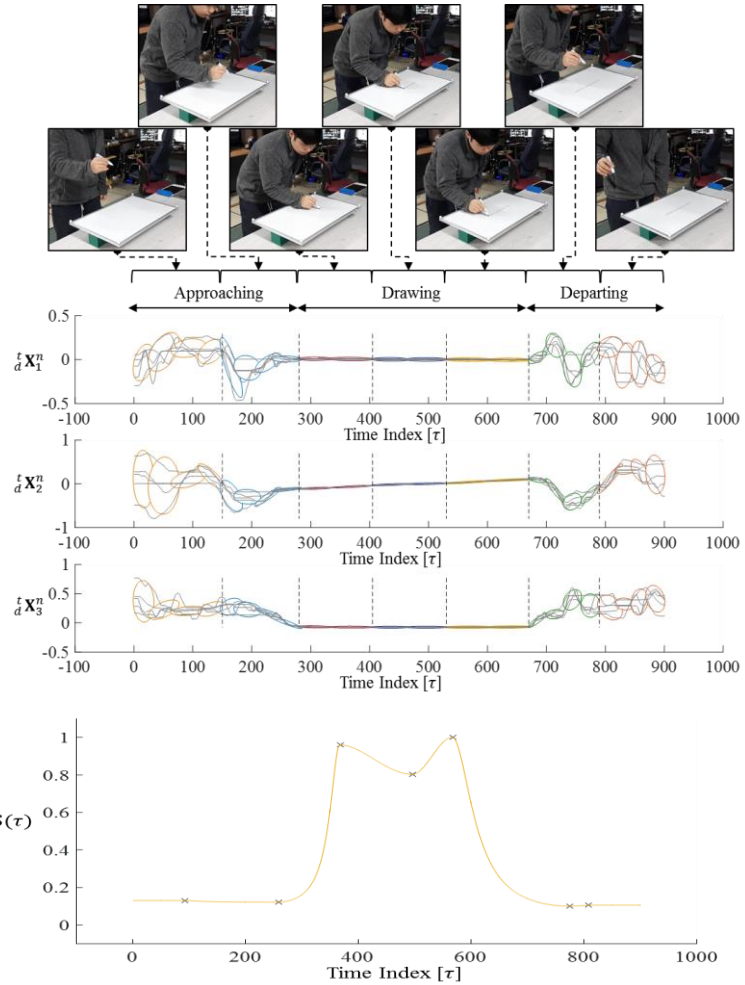








Motion Significance

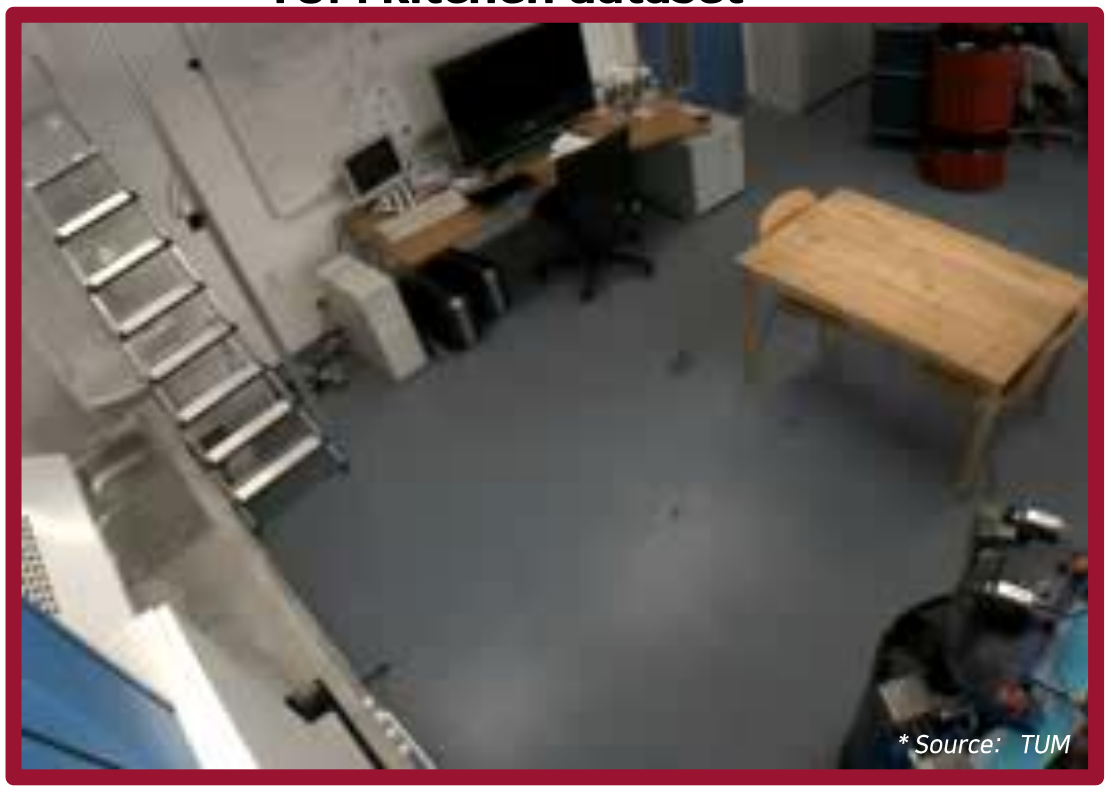


I. H. Suh et al., "Measuring motion significance and motion complexity," Information Sciences, 388, 84-98, 2017.

Human Demonstration

Motion segmentation in a demonstration

TUM kitchen dataset

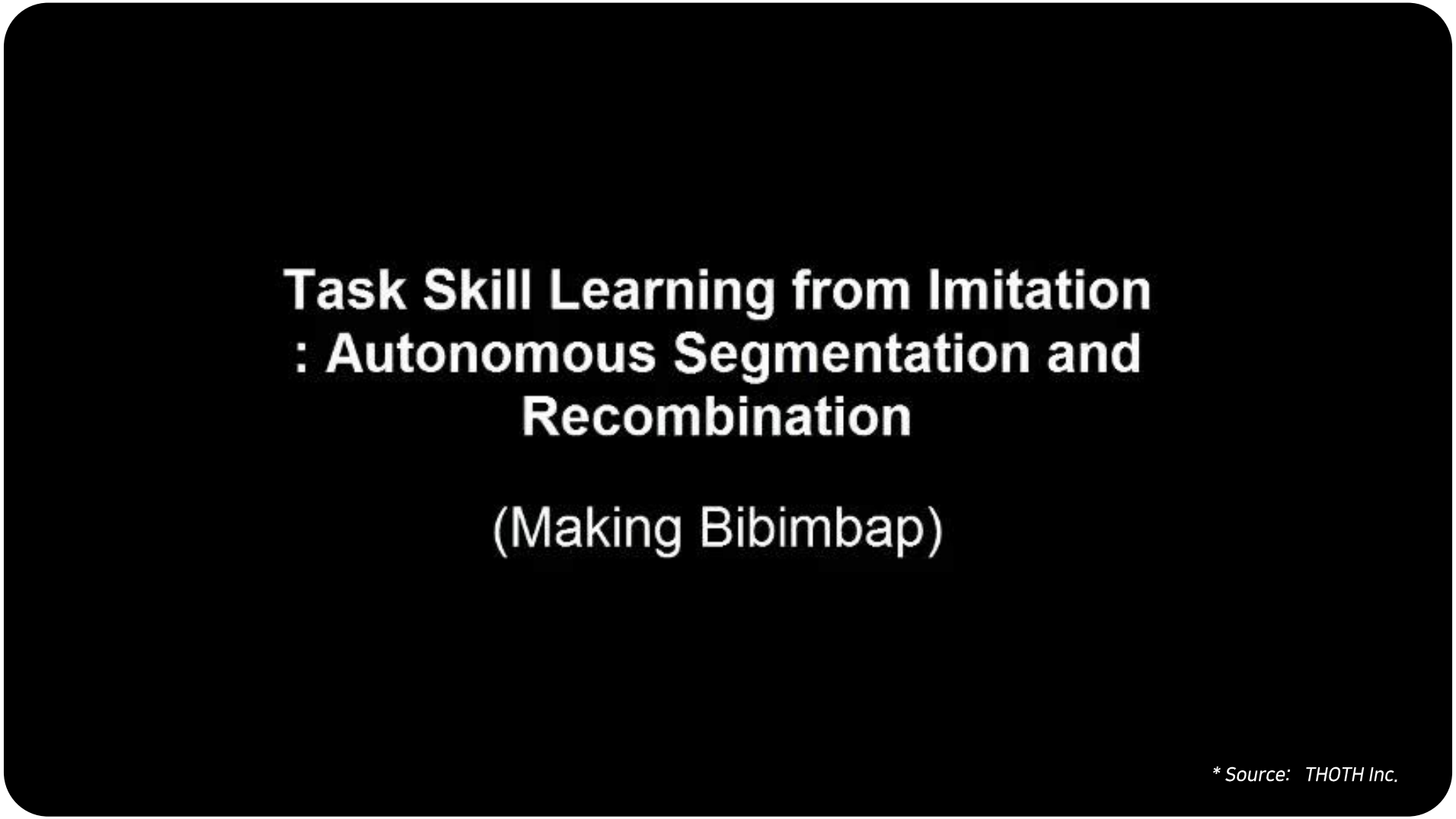


** Source: Reproduction byTHOTH Inc.*

Similarity 92%

Human Demonstration

Advantages of motion segmentation in a demonstration



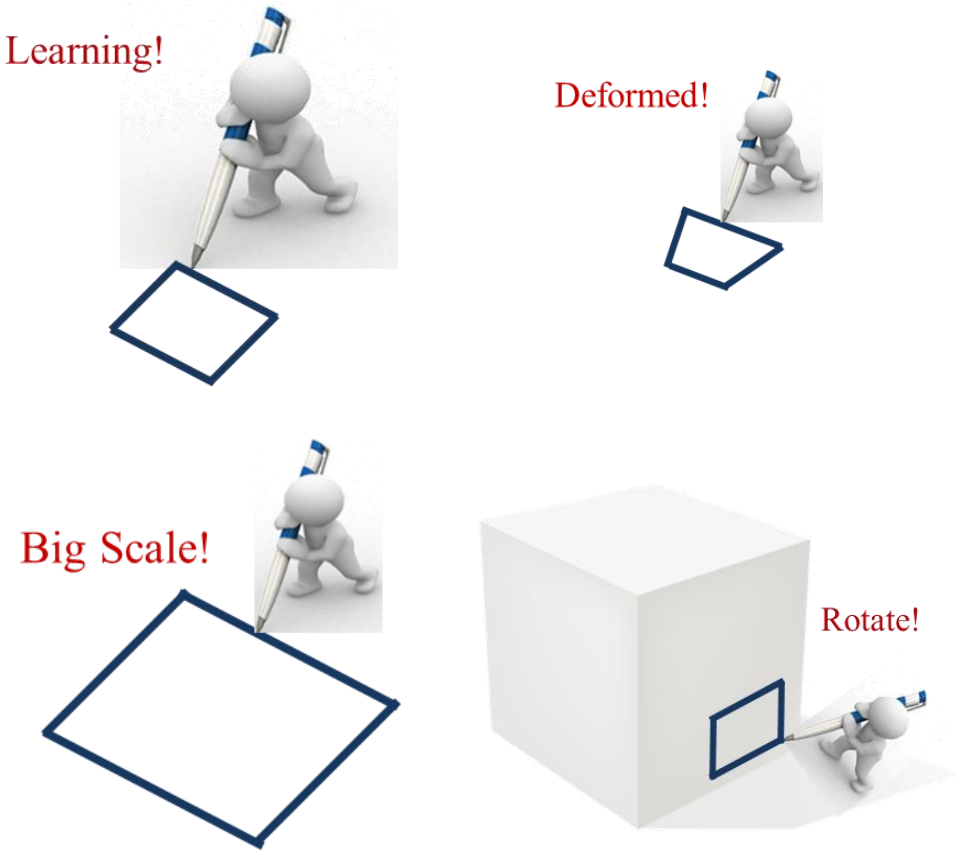
** Source: THOTH Inc.*

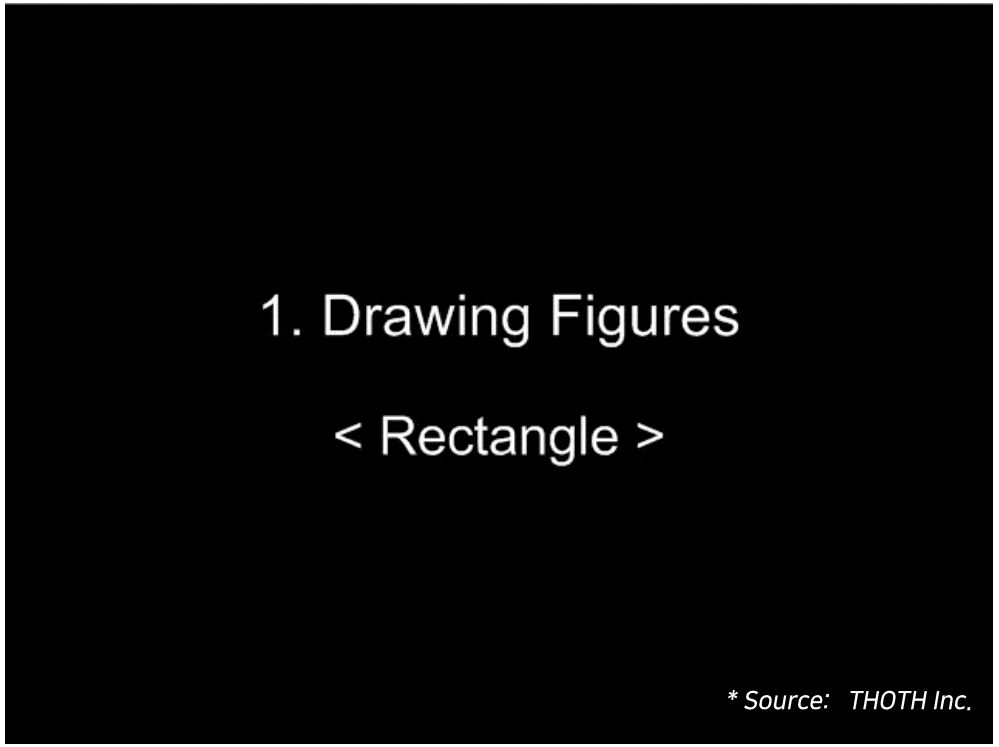
Human Demonstration

Advantages of motion segmentation in a demonstration

Human Demonstration

Advantages of motion segmentation in a demonstration





** Source: THOTH Inc.*

The need for physics-engine-mounted simulation

** Source: THOTH Inc.*

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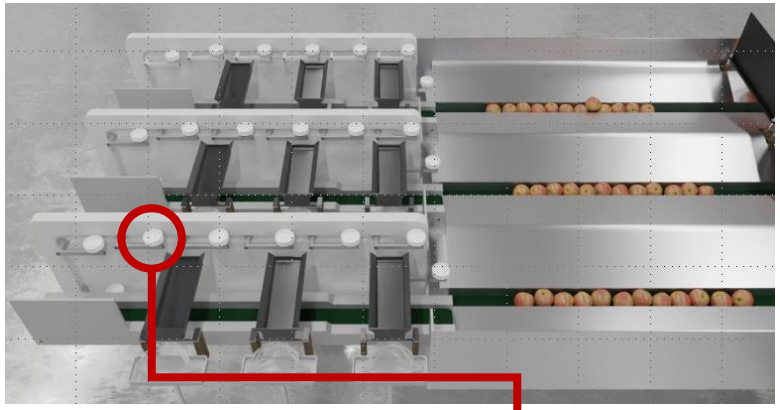
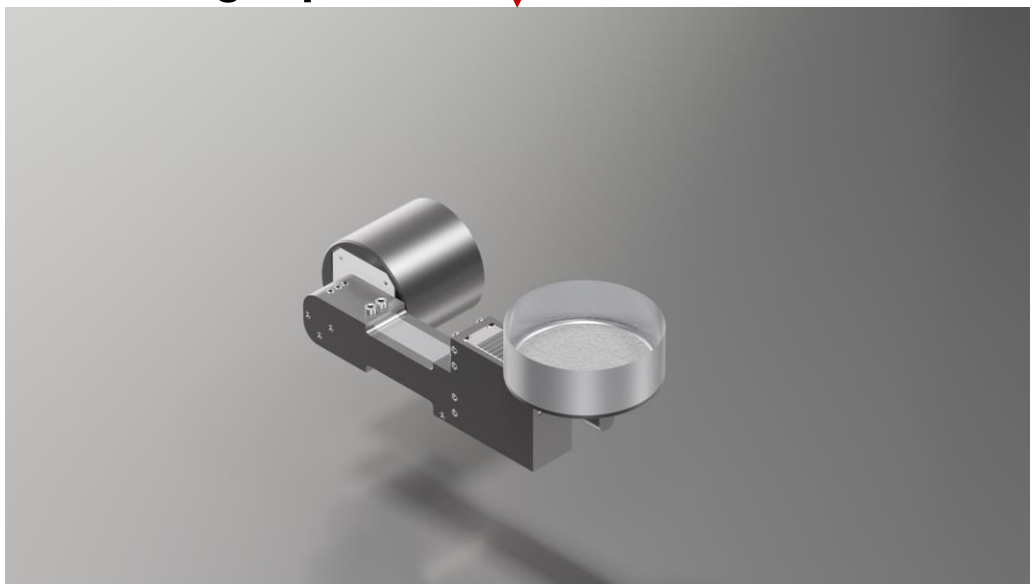
The need for physics-engine-mounted simulation

HCP-T01

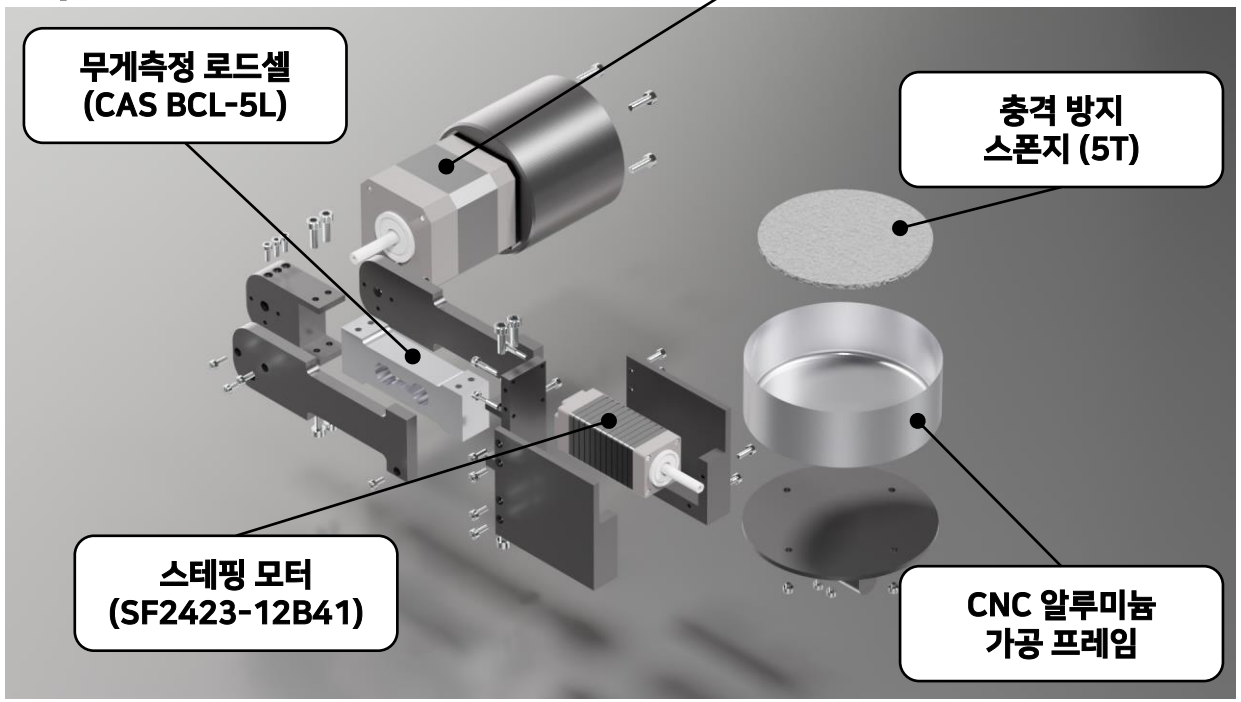


Measuring cup (MC-01)



"Modeling with parts for sale"

Exploded view of MC-01



※ 연결 부품은 강화 플라스틱 및 M2 & M3 렌치볼트 사용

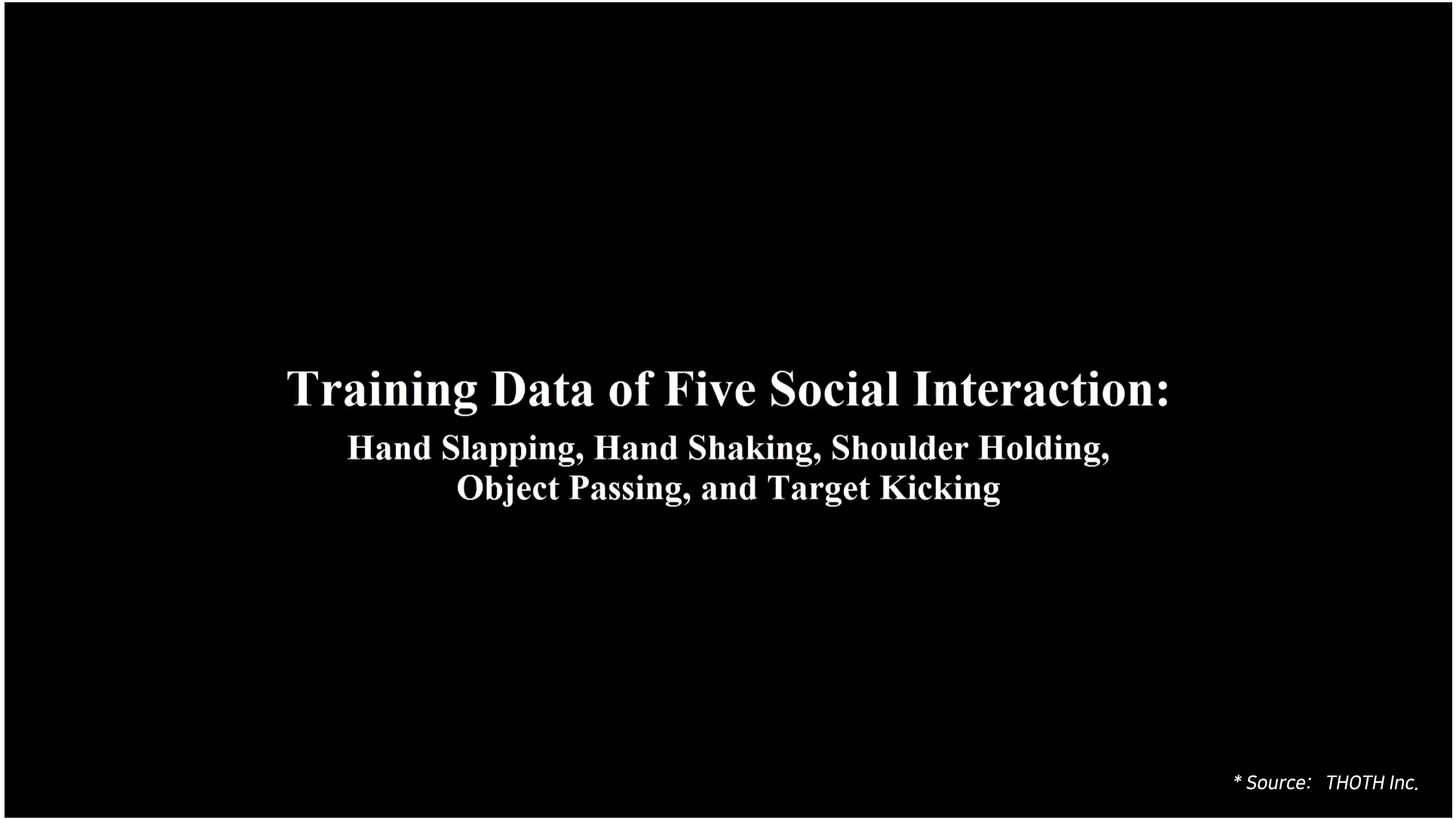
Reaction between virtual characters

The importance of reactions between virtual characters

* Source: 너를 만났다, MBC

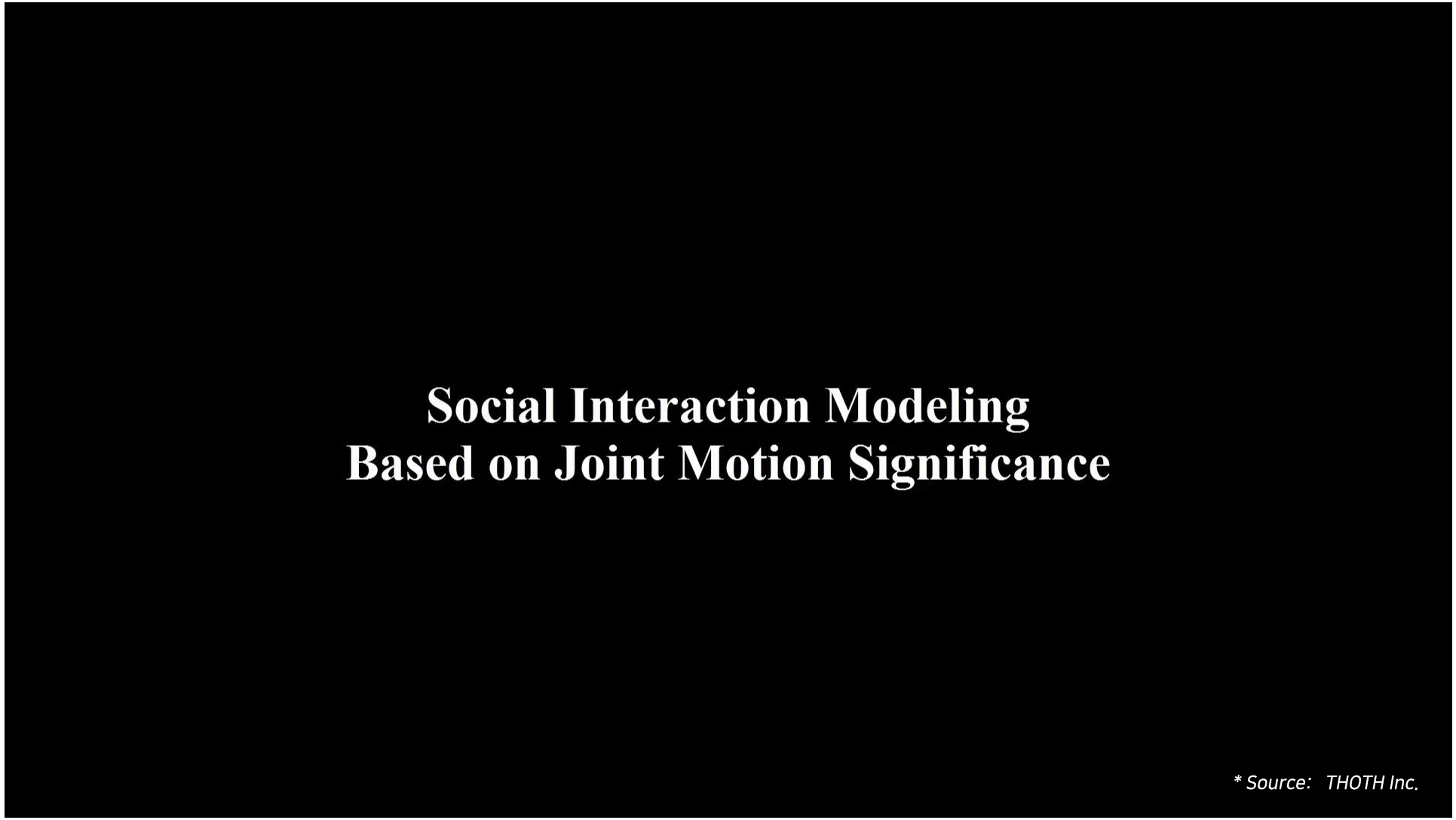
01:05, 01:34

The importance of reactions between virtual characters



** Source: THOTH Inc.*

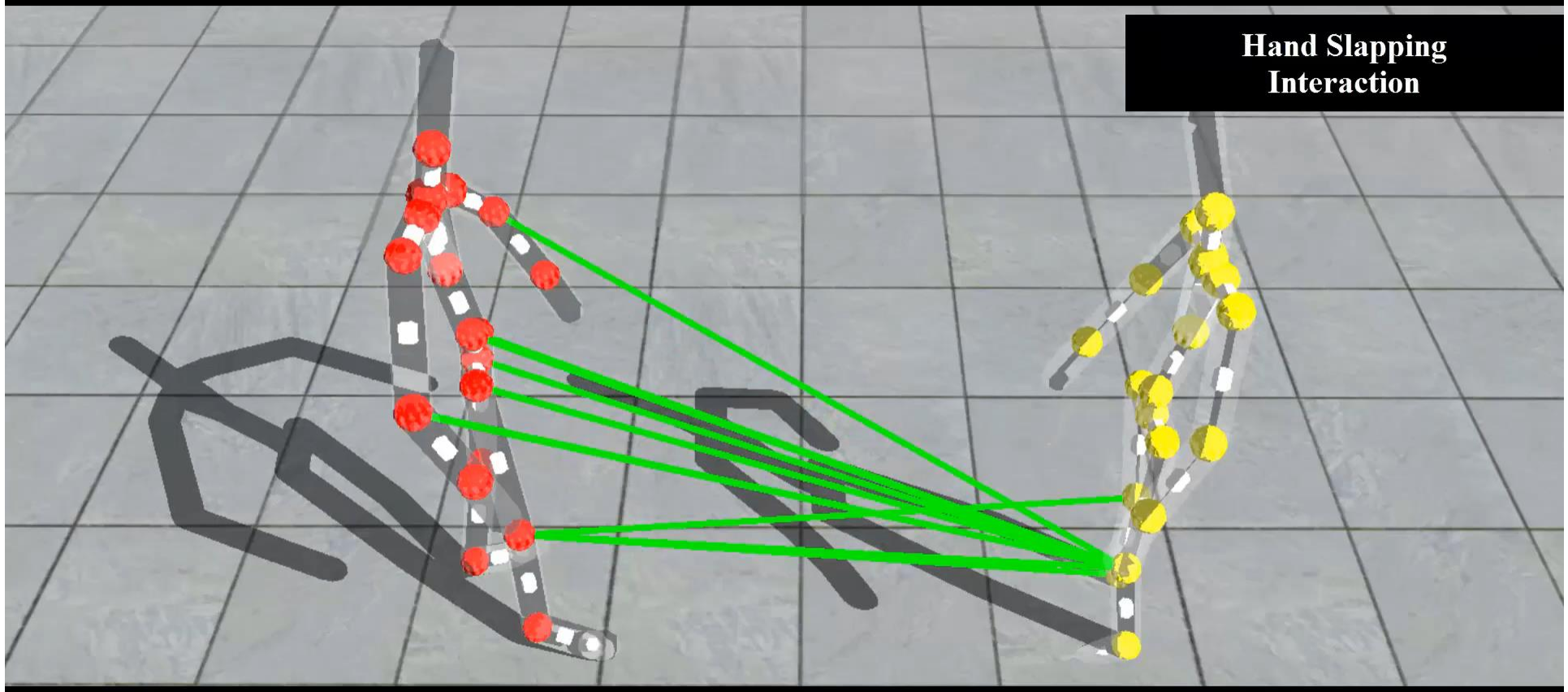
The importance of reactions between virtual characters



** Source: THOTH Inc.*

The importance of reactions between virtual characters

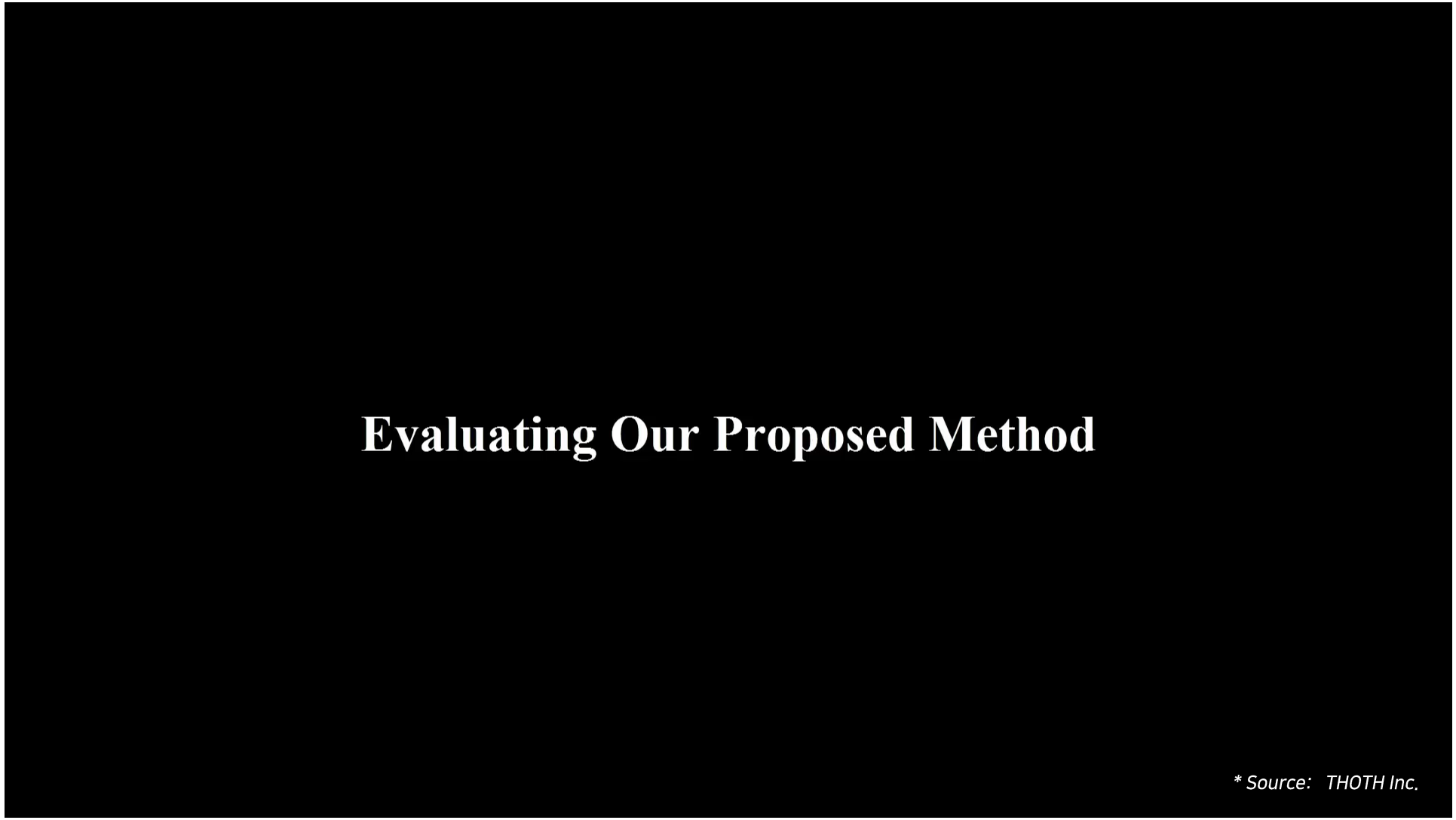
The Significant Features Selected as The Top Nine by The Joint Motion Significance



Significant Features Selected by Our Method

** Source: THOTH Inc.*

The importance of reactions between virtual characters



** Source: THOTH Inc.*

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AI-based Robot Automation One-stop Solution