13th CDTI - NEDO Joint Workshop
"AI-Equipped Collaborative Robot Technology"
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Consideration of autonomous swarm control of robots and spatial compression of collected data (AdS/CFT compatible)

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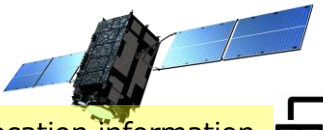
Introducing LOOM.0x

- ✓ We are a startup based in Seki City, Gifu Prefecture (opening in September 2024)
- ✓ We are researching and developing voice conversations between robots and people, people and people, and robots and robots.
- ✓ Research and development of a conversational, autonomous collaborative robot that recognizes things through voice input and camera object recognition.
- ✓ The first private-sector implementation of Swarm control for agricultural self propelled robots.

Importance of Swarm control

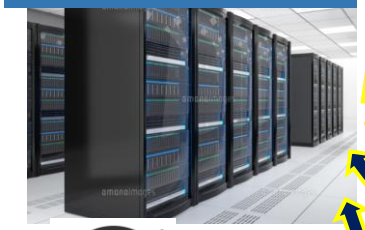
Basic technology for avoiding collisions with humans (or other robots) on farms when humans and robots work together

Utilizing swarm control in agricultural fields



the current

computer



programming

Screen operation

TXT

Location information

TXT

Navigation record

TXT

TXT

Weather information
Or Growth record

TXT

TXT

Operation log

computer vision

physical calculation

$e^{i\theta}$

$e^{i\theta}$

Farmland after utilization

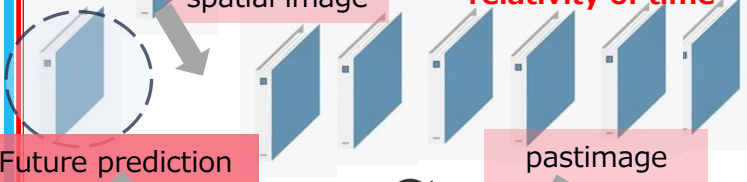
Swarm control with LOOM

AdS/CFT
compatible

Super computer[GPU]

spatial image

relativity of time

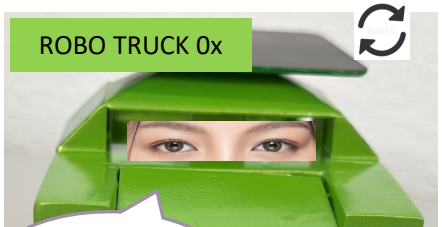


Future prediction

pastimage

Language translation for large-scale language models(LLM)

ROBO TRUCK 0x



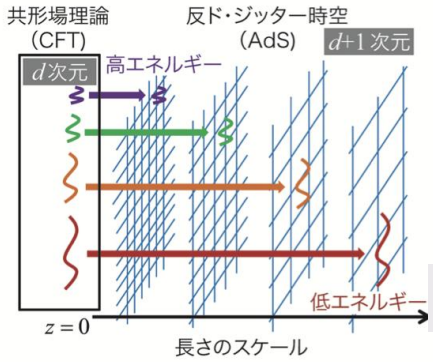
Nice to meet you.

こんにちは。

voice input

Research and development example [Robot control platform LOOM]

- ✓ In an environment where many people and collaborative robots work together, the robots' three-dimensional views obtained from their large amounts of camera sensor information are spatially compressed and shared, enabling intuitive conversation.
- ✓ Supercomputers and other devices perform instantaneous parallel processing, enabling real-time conversation and seamless collaboration.
- ✓ Research and development into robot control platforms.
- ✓ Spatial compression uses data quantization and AdS/CFT support.



出典：日本物理学会誌 **Vol. 69, No. 2, 2014**

図1　AdS/CFTの概念図．共形場理論における波長L程度の摂動は，反ド・ジッター空間では$z=L$付近の変形（重力波）に相当する．

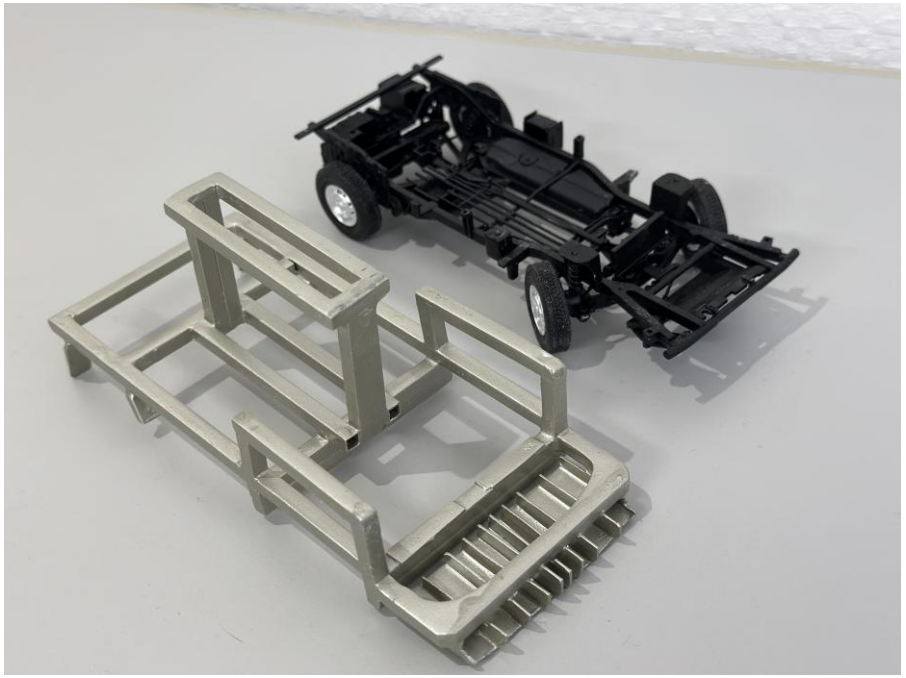
1-3 **Dictionary of AdS/DL correspondence**

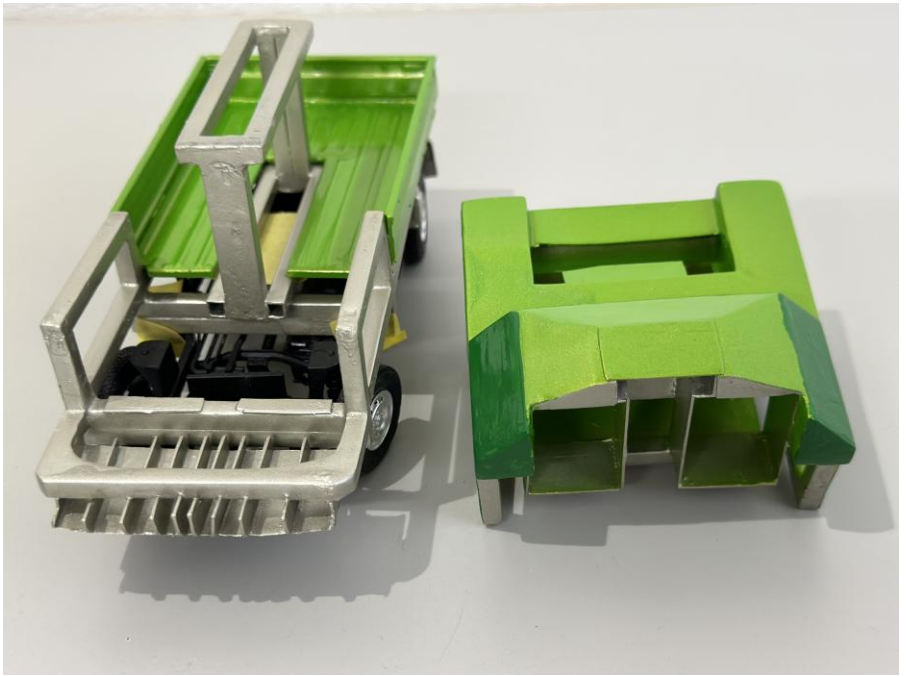
AdS/CFT	Deep learning
Emergent space $\infty > \eta \geq 0$	Depth of layers $i = 1, 2, \cdots, N$
Bulk gravity metric $h(\eta)$	Network weights $W_{ij}^{(a)}$
Nonlinear response $\langle \mathcal{O} \rangle_J$	Input data $x_i^{(1)}$
Horizon condition $\partial_\eta \phi \mid_{\eta=0} = 0$	Output data F
Interaction $V(\phi)$	Activation function $\varphi(x)$

出典：**Deep Learning and AdS/CFT**
https://arxiv.org/abs/1802.08313

Research and development example [Robo truck 0x]

- ✓ An automobile manufacturer plans to add an edge computer with ROS2 installed to mass-produced vehicles.
- ✓ We are currently researching and developing an interface between AUTOSAR and ROS2.
- ✓ We would like to create a prototype vehicle.
- ✓ This will be basic research and development of robotics technology (including LIDAR, depth sensors, and spectroscopic sensors) that can be deployed for applications other than transportation.





Automated transport between farmlands will increase agricultural productivity in a mobile society[Robo truck 0x & LOOM]

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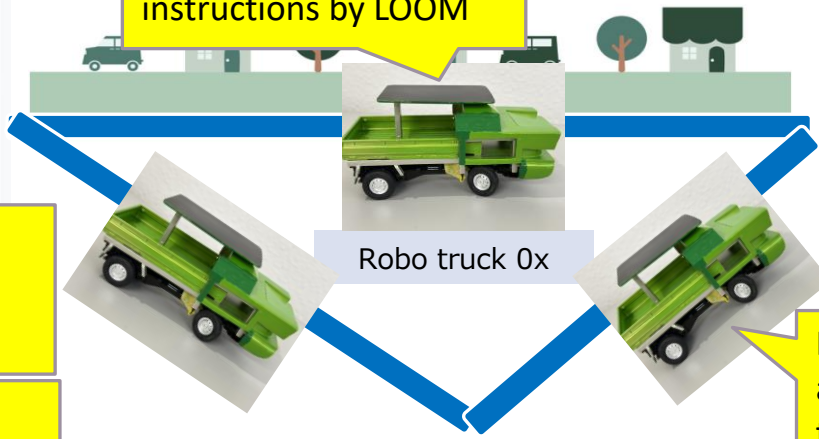
farmland

・Crop production
・Soil and compost production

Automatic transport instructions by LOOM



Robo truck 0x

logistics

export

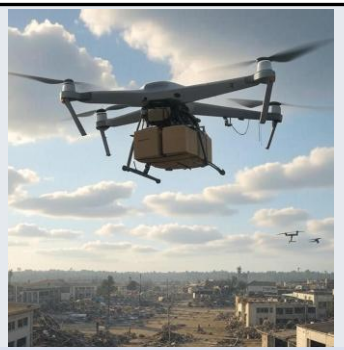
Hydrogen and ammonia transport

24-hour standby, fully automated transport of supplies in the event of a disaster

regional energy center

Robot control platform LOOM

SMR



Disaster drone

Local Energy Production and Consumption
- Power Generation
- Regional Power Distribution
- Hydrogen Production
- Ammonia Production
- Chemical Fertilizer Production

Data Storage(by LOOM)
- Security Measures
- Disaster and Emergency Preparedness

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When a major earthquake occurs, will drones be able to deliver relief supplies before the Self-Defense Forces can?

LOOM.0X ルームコネクトオックス

Examples of Swarm Control Applications
[Mobility Increases Productivity Beyond Agriculture]

- The system captures the location of the earthquake and the extent of the damage
- Compiling a list of relief supplies according to the damage situation
- Optimal routes are determined and deliveries begin simultaneously
- Record the local situation upon arrival and collect information

[Robot Implementation]
Equipped with an edge computer with high processing capabilities
(image recognition, voice input, object detection)

[Swarm control implemented using the robot control platform LOOM]
Calculating relative time to support swarm control
(quantizing data obtained from sensors)

[Swarm control implemented using the robot control platform LOOM]
Instantaneous physics calculations are performed on the host, and learning data is shared between robots.
(Future-predictive actuator control that takes into account the interactions between robots)

[Robot Implementation]
Lightweight data transfer
*A method for spatially compressing large amounts of data is required.

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Would you like to exhibit with us at the Japan Mobility Show 2027 in two years?

- ✓ Joint research and development of AUTOSAR and ROS2 interfaces
- ✓ Joint research and development of spatial compression using data quantization and AdS/CFT correspondence
- ✓ Robo Truck 0x basic design and prototype joint production
- ✓ The three themes above will be jointly exhibited at the Japan Mobility Show 2027 in two years' time

Thank you for your attention.

We would like to exhibit the actual vehicle at the Japan Mobility Show 2027 in two years!

Photo of the 0x concept exhibited at the JMS2025 Tokyo Future Tour 2035