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Press Release

Keio University

ChatMPC: Control System Improvement via User-Machine Conversation

Associate Professor Masaki Inoue and Assistant Professor Yuya Miyaoka (fixed-term, PhD 1st year) of the Keio University Department of Applied Physics and Physico-Informatics, in collaboration with Professor Jose M. Maestre, have developed a technology called ChatMPC.

ChatMPC enables real-time improvement of control systems through simple, casual, and conversational interaction with users. By integrating an AI model that interprets verbal interactions with a control algorithm that ensures system safety, the system can remain reliable, even under ambiguity in user instructions or AI fluctuations.

These research results were published as a rapid release in the IEEE journal *Transactions on Control Systems Technology* on 30 May, 2026 (Japan Time).

1. Main Points of Research

- Updating control systems using “everyday language”: Without requiring specialized knowledge, users can improve the behavior of machines, such as autonomous vehicles or robots, by simply using natural language instructions like “Go faster”, or “Run farther away from baby”. This allows the control system to adapt its behavior in real time to suit the environmental conditions and personal preferences (see Fig. 1).
- Combining AI and control theory for “safety and security” operation: ChatMPC applies AI-based foundation model (e.g., Sentence BERT (*1)) to convert user intent into numerical representations. These are then used to update control parameters. Unlike fully AI-dependent instruction processing, ChatMPC ensures safety even when human instructions are ambiguous or AI outputs are uncertain, allowing trustworthy human-in-the-loop control.

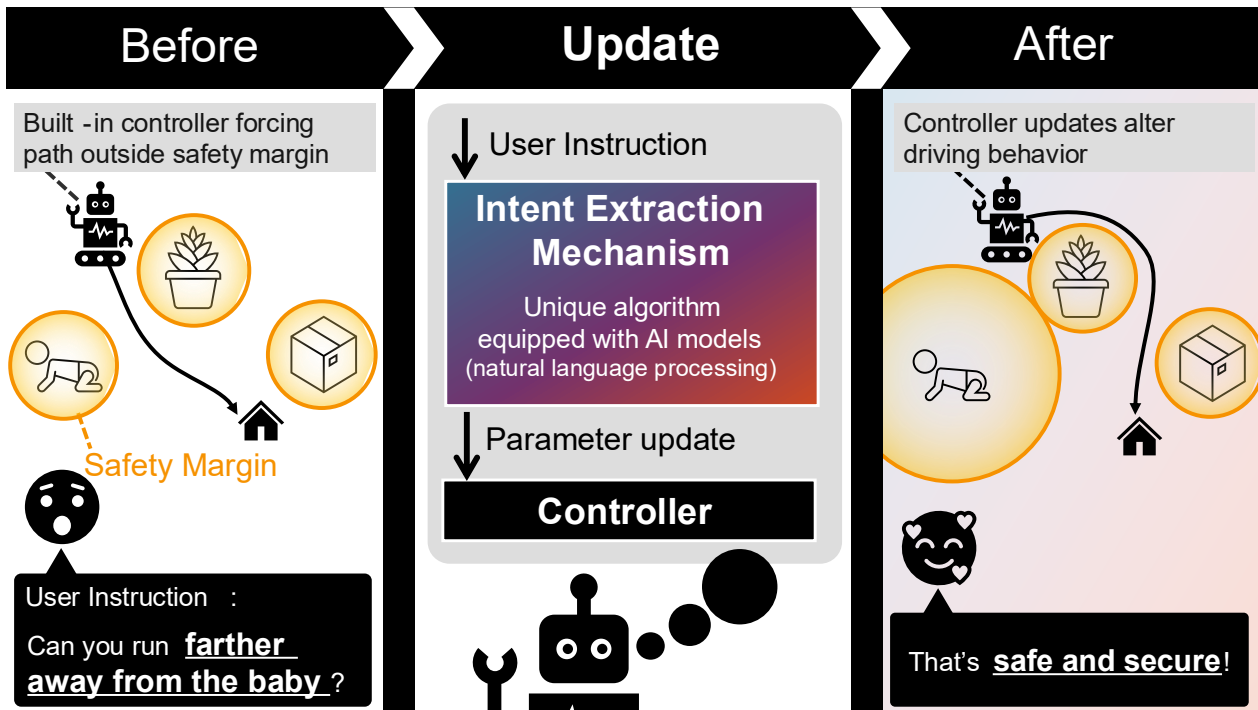


Fig. 1 Control system update using natural language

2. Background of Research

Even with advanced AI and control theory, designing a control system that completely matches real-world environments and individual user preferences is still difficult. Current challenges include (1) The need for expert knowledge to adjust control systems, and (2) The burden and cost of collecting detailed environmental data and user preference data. Addressing these challenges is essential for the implementation of advanced control technologies in real-world applications.

3. Content of Research and Results

This research developed ChatMPC, a conversational Model Predictive Control framework. It allows users, without specialized knowledge, to adjust their control systems according to environmental conditions or personal preferences, using natural language as an intuitive and casual interface.

ChatMPC allows real-time integration of user instructions during the control operation, enabling flexible human-machine cooperation. For example, it supports (1) Compensating for sensor failure: In emergency situations such as sensor failure, user can verbally compensate the missing sensor data, allowing continued safe operation. (2) Executing unexpected tasks: Users instruct the system to perform unplanned actions based on real-time observations.

In addition to the foundational algorithm of ChatMPC, this research also provides theoretical analysis of safety guarantee and a simulation experiment with autonomous vehicles, where a remote operator verbally supplements external information to maintain safe navigation.

4. Future Developments

The scope of this technology extends from physical systems, such as autonomous vehicles and

robotics, to social infrastructure, including energy management and traffic flow control. To successfully deploy advanced AI in real-world environments, ensuring safety and reliability remains the critical challenge. By further refining ChatMPC's capability to safely and precisely translate human intent into physical world, this research aims to advance a technologies that allow human and AI to cooperate seamlessly in real-world environments.

Research Funding

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Details of Journal Article

Yuya Miyaoka, Masaki Inoue, and Jose M. Maestre, Chat-driven reconfiguration of model predictive control, IEEE Transactions on Control Systems Technology, 2026 (early access).

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Special Notes

*1 Sentence BERT: An AI model that vectorizes the meanings of natural-language texts. This enables us to make “linguistic nuances” processable by computers.

*2 Model Predictive Control (MPC): A control method that predicts future behavior based on a model of the controlled system and iteratively calculates optimal control operations while satisfying constraints.

*Please direct any requests or inquires to the contact information provided below.

• Inquiries about research

Department of Applied Physics and Physico-Informatics, Faculty of Science and Technology,
Keio University

Professor Masaki Inoue

Tel: +81-045-566-1567 Email: minoue.z6@keio.jp

<https://sites.google.com/keio.jp/minoue-eng>

• Inquiries about press release

Keio University Office of Communications and Public Relations

Tel: +81-3-5427-1541 Fax: +81-3-5441-7640 Email: m-pr@adst.keio.ac.jp

<https://www.keio.ac.jp/en/>