NEC Corporation
Nidec Corporation

NEC and Nidec develop technology to control robots equipped with Intelligent Motors

Tokyo, December 6, 2017 – NEC Corporation (NEC; TSE: 6701) and Nidec Corporation (Nidec; TSE: 6594; OTC US: NJDCY) announced today the successful joint development of a technology that enables highly precise, real-time remote control of Intelligent Motors (*1), motors incorporating microcomputers through a wireless network.

As utilization of the Internet of Things (IoT) accelerates, there is greater need for robotic equipment to communicate and work together cooperatively in the growing robotics industry. In consideration of this demand, NEC and Nidec have successfully developed a new technology that combines NEC's wireless communication technology with Nidec's motor synchronization technology to enable highly precise, real time remote control of Intelligent Motors through a wireless network.

NEC's wireless communication technology accurately predicts the future operational status of Intelligent Motors in the event of a wireless network communication delay. This enables the motors to be remotely controlled in real time, and for future operations to be adjusted based on prediction results.

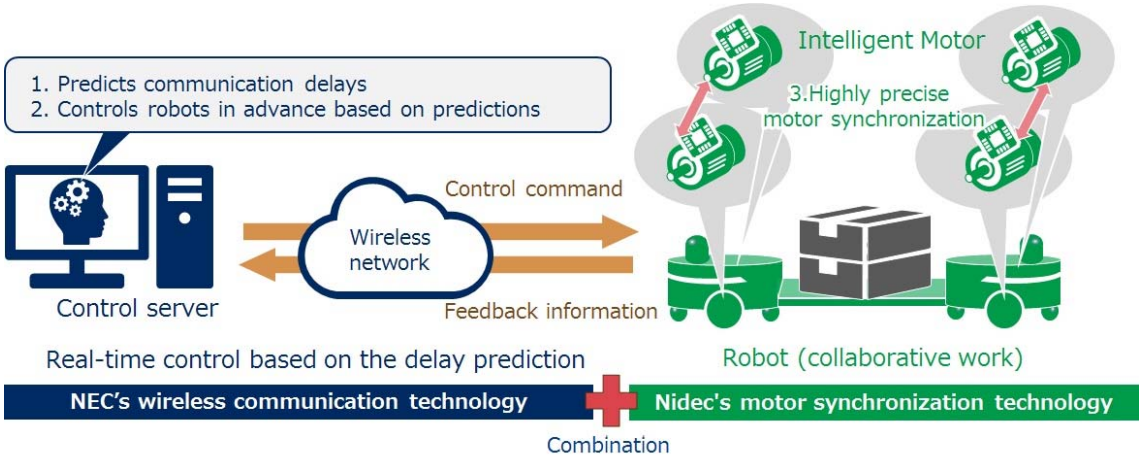
In addition, Nidec's motor synchronization technology enables multiple Intelligent Motors to interact with each other through highly precise synchronization between them, or among multiple robots equipped with Intelligent Motors.

This newly developed technology has been verified by simulation

testing with automated guided vehicles (AGVs), in an environment where wireless communications were unstable due to the data transmission of peripheral equipment and the influence of electromagnetic noise. According to the testing, the technology could improve transportation efficiency (*2) by 30% compared to conventional methods.

Going forward, NEC and Nidec will promote commercialization of this technology throughout a wide range of fields, including automatic carriers in plants and warehouses, security robots, reconnaissance robots, and remote control of drones for inspection and delivery.

NEC will present this technology at the IEEE International Conference on Consumer Electronics (ICCE) 2018 in Las Vegas from Friday, January 12 to Sunday, January 14, 2018.
URL: http://www.icce.org/



Wireless collaborative control technology

Features of the new technology

1. Predicts communication delays between a control server and Intelligent Motors

   The highly precise stochastic model was discovered over the occurrence of delays on various wireless networks, such as Wi-Fi and LTE, and communication delays were successfully predicted through its utilization (Note 3).

2. Achieves advanced, real-time remote control based on communication delay prediction

   Communication delay prediction technology can predict how much time has elapsed since feedback information (position, velocity, torque and others) was sent from Intelligent Motors and how much of a delay there will be for an arrival of the control commands (orders on position and velocity) to Intelligent Motors.

   With this prediction, the technology accurately estimates the status of Intelligent Motors at the time that the control commands will be received. It then controls the motors in advance on the basis of the predicted future status (Note 4), enabling real-time control, even from a remote site where communication delays occur.

3. Collaboratively controls robots with highly precise synchronization between motors

   Intelligent Motor is a motor equipped with a microcomputer developed by Nidec, enabling easy control through a wireless network. The developed motor synchronization technology hereby achieves highly precise synchronization by having multiple Intelligent Motors interact frequently, enabling the coordination control of multiple robots equipped with Intelligent

Motors. In addition, an expensive computer is no longer necessary for control, which was conventionally required on the side of robots. As a result, for conveying operations in plants and warehouses, it becomes possible to transport parcels of various shapes and weights, not by a large, high-cost automated guided vehicle, but through the combination and collaboration of multiple small, low-cost automated guided vehicles. This contributes to low-cost operations.

(*1) Intelligent Motor
A motor incorporating a microcomputer developed by Nidec. It can be easily controlled through a wireless network. In addition, a variety of information on the motor can be obtained, such as position, velocity and torque.

(*2) Transportation efficiency
Time required for an automated guided vehicle conveyance to prevent deviation from a certain route by remote control.

(*3) Communication delay prediction
With the definition of two states of communication networks, high-delay state and low-delay state, it was discovered that the transition model of the two delay state could be predicted very precisely using a certain molecule's stochastic model of the state of transition between a high-energy state and a low-energy state. It was demonstrated that the method could improve prediction error by about 30%, compared to the latest outcome in the same kind of research in a real network environment.

(*4) Advance control
A control method by predicting future states in the control system. The presentation at IEEE ICCE 2018 will be given centered on this control technology.