■Technology details

Features of the newly developed robot control technology include the following.

1. Technology for real-time switching of the importance of multimodal sensor information based on the work to be performed and the environment (hereinafter, "modality attention mechanism")

The processing for integrating multimodal sensors, such as for vision and tactile force, and making decisions, until recently had to be designed by humans. Today, however, this processing can be generated automatically by robot learning. A problem that arises, however, is that since the importance of each sensor information changes with the kind of work being performed and the environment, some operations become unstable when all sensor information is treated (learned) equally. With the newly developed technology, humans simply teach the robot multiple times the work to be performed. The robot learns the importance of sensor information (i.e., learns the "knack" for doing the task), and becomes able to perform the work by focusing on specific sensor information based on the nature of the work and the environment (Figure 1).

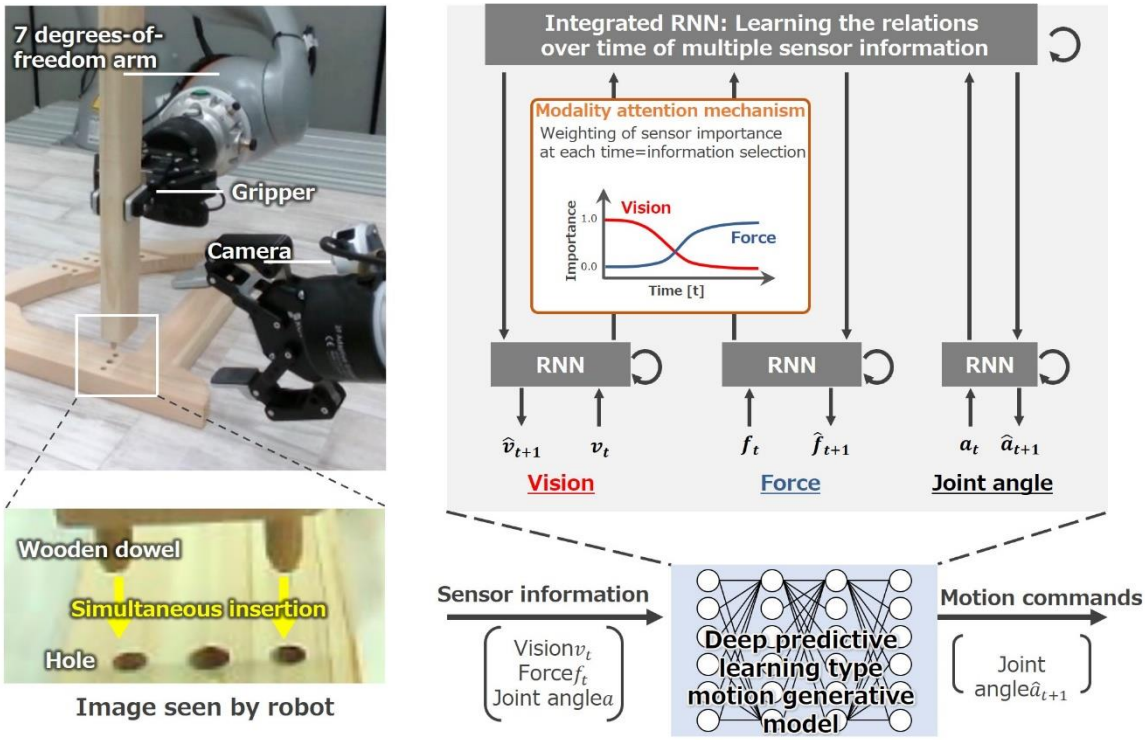

Figure 1: Technology for real-time switching of the attention paid by a robot to vision and force sensor information based on the work to be performed and the environment (modality attention mechanism)

2. Improvement in model interpretability and noise robustness

Without the above modality attention mechanism, sensor information not necessary for the work is also used in deciding and executing robot motions, so that such information becomes noise, lowering the robustness of robot operations. With the new technology, the robot can focus on the sensor information important to the task, and the ability to perform stable work even in the case of unanticipated events has already been demonstrated, such as in cases where obstructions occur in the robot field of vision, or a force that did not exist in the planning stage is applied (Figure 2). In this demonstration aimed at verifying the effectiveness of the modality attention mechanism, an actual robot performed a chair assembly task while adjusting the position and force of the hand performing the work. The results confirmed that importance (attention) was higher for vision information when positioning the part, and for force information when inserting the part. By visualizing importance (attention) levels while a robot is performing a task, it becomes possible to interpret which sensor information is contributing to the operation, leading to digitalization and automation of tasks that were difficult to code in programs.

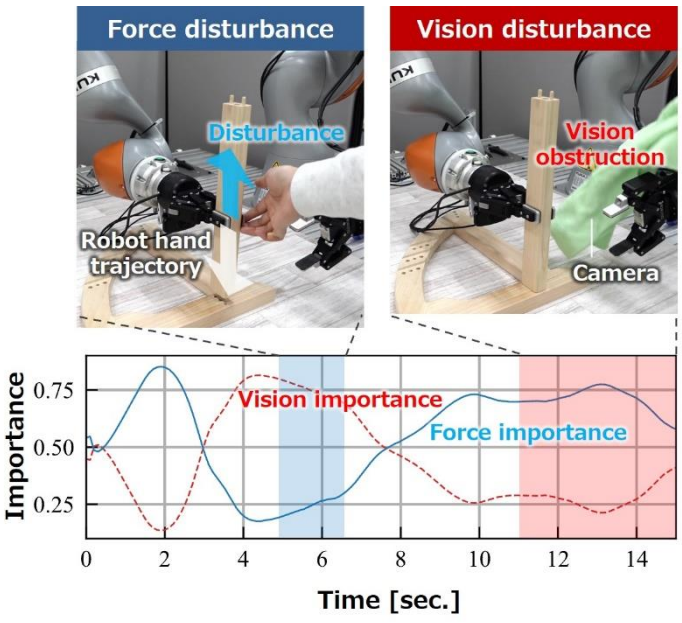

Figure 2: Changes over time of the importance of vision and force information during disturbances in the work environment