Progress Report

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A. **Title:** Formation control for a team of autonomous mobile robots adapting to a changing environment

B. **Aim of my research**

New formation control strategies based on human-robot and/or robot-robot interaction are developed for a team of multiple mobile robots to improve the task performance and fault-tolerance in unstructured or dynamic environments.

C. **My approach and Idea**

Recently, a vast amount of studies have been conducted in the field of cooperative mobile robotics. However, traditional cooperative works through multiple robots mostly enable the design of multiple robot systems in a single mode of operation, in which the task and the model of robots are fixed. When operating in unstructured or dynamic environments with many different sources of uncertainty, it is very difficult if not impossible to design the architecture of multiple robot systems that will guarantee performance even in a local sense. The objective in my research is to establish a paradigm that allows us to design simple multi-robot architecture whose performance can be analyzed and predicted using a cooperative formation control algorithm, and to develop tools that allow us to construct multiple robot systems with adaptations in behavior that can be used in the development of intelligent robotic systems.

D. **Progress of this year**

1. Interaction strategies between the human operator and the robot

A new framework of interaction was proposed for teleoperating a mobile robot integrating the operator intention and the robot autonomy. The basic concept is to transmit robot's state information to the operator that includes the current task followed by the next task to be performed and the reason of the task selection and the estimated execution task. High-level commands of the operator and the autonomy of the robot system can be integrated more harmonized way. Specially, our research aims to maximize performance of task executions for the autonomous robot while minimizing operator intervention. Decision assistance information according to autonomous robot's states plays an important role in a standard of judgment for operator's interventions.

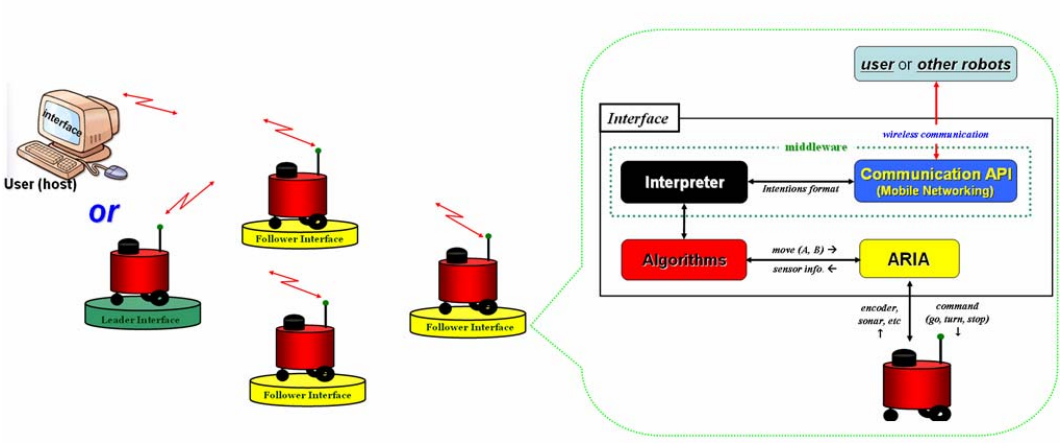
2. Distributed cooperative algorithm for the coordination of autonomous multiple robots

Although a vast amount of studies have been conducted in the field of cooperative multiple mobile robots, unfortunately, only few researches address it from a computational standpoint which means that much remains to be done to develop its theoretical foundation. My research related to this field aims at improving the current situation by providing a consistent framework

for problems involving cooperative autonomous multiple mobile robots. I am now studying the distributed coordination of a set of synchronous, anonymous, memoryless mobile robots that can freely move on a two-dimensional plane. Based on this model, I'm analyzing the application problem that consists in having a group of robots form a barricade line to protect from car traffic a crowd of demonstrators parading on the street. For the sake of robustness, I will privilege fully decentralized solutions to the problem.

E. Future direction

1. Developing the framework for the cooperative team of autonomous multiple robots



2. Proving the distributed cooperative algorithm of autonomous multiple robots in the computational standpoint
3. Evaluating the interaction strategy and the distributed cooperative algorithm using the real mobile robots

F. List of my publication

1. **Geunho Lee** and Nak Young Chong, *"Supervised Autonomy in Mobile Robot Navigation"*, The 22nd Annual Conference of Robotics Society of Japan, Sep. 15~17, 2004
2. Komatsu, **Geunho Lee**, and Nak Young Chong, *"Generation of formation for multiple autonomous mobile robots adapting to an environment"*, Robotics and Mechatronics 2005, June. 9~11, 2005 (*submitted*)