Multi-agents Generic Model for Piloting Mobile Manipulator Robots

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Abstract

In this article, we present multi-agent based system generic model architecture for distributed control. This model is dedicated to pilot mobile manipulator robots. The choice of the suggested approach is justified by the generic character of the proposed agent model and on the other hand, by the possibility of integrating the whole in a distributed robotic system (example: CDTA's flexible manufacturing system). The proposed control architecture model is based on a meta-agent composed by four hybrid agents what makes possible to obtain adapted behaviors to the various situations. This architecture privileges control and knowledge distribution and coordinated management of the unforeseen situations. This model is composed by the following agents: Supervisor Agent (system management), Mobile Robot Agent (mobile base control), Manipulator Robot Agent (manipulator control) and Graphic Simulator Agent (real time graphic verification of tasks execution).

Key words:
Control architecture, Multi-agent System, Mobile manipulator robot, RobuTER, SynDEx.

1. Introduction

Recently, various research tasks on the use of the multi-agents systems were realized. The multi-agent paradigm was largely adopted in complex systems and distributed applications and, in particular, those dedicated to the robotic systems control (flexible manufacturing systems, mobile robots, manipulator robots and mobile manipulator robots).

Multi-agent control is necessary when more than one robot is used to execute tasks, when a robot must coordinate the use of its own resources (example: for a mobile manipulator robot, coordinating his arm and his platform) or when a robots society function independently on multiple tasks in a shared environment. Among the advantages of such a system we can note: research of a solution in a global viewpoint with a local vision, effectiveness (parallel functioning when material and software environment allow it), reliability (functioning in a degraded environment), reuse of agents for the implementation of other systems, etc. Nevertheless, the development of this type of autonomous robots control systems includes several problems such as: choice of agents' types, communication protocol, communication and interaction mode, conflicts management, environment modeling, tasks planning, scheduling, etc.

To pilot flexible manufacturing systems (FMS), several works were realized: [1], [2], [3], [4], etc. The CDTA's FMS control architecture developed in [1] and [2] is based on a multi-agents system and used the *Contract Net* protocol [5] for the operations redispatching in case of a dysfunction. The proposed approach models the cell by a cognitive agents' society. This architecture consists in assigning each resource of the cell to a *Resource Driver Agent*. The *Task Manager Agent* is the supervisor of the cell. The implemented software architecture attributes a PC to each resource of the cell and each *Resource Driver Agent* is running on the associated resource computer. Leitão and *al.* [3] have also proposed the *ADACOR* architecture (*Adaptive and Cooperative Control Architecture for Distributed Manufacturing Systems*) to control their flexible cell. The software architecture defines a set of agents classes: *Operational Agent* (interacts with the physical resource), *Supervisor Agent* (manages the *Operational Agents*), *Product Agent* (represents available product in the system), *Task Agent* (executes machining tasks) and finally *System Management Agent* (administrates the system).