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A combined auction mechanism for online instant planning in multi-robot transportation problem

Mansour Selseleh Jonban[*1], Adel Akbarimajd[2a] and Mohammad Hassanpour[1b]

[1]*Young Researchers and Elite Club, Ahar Branch, Islamic Azad University, Ahar, Iran*
[2]*Electrical Engineering Department, Faculty of Engineering, University of Mohaghegh Ardabili, Ardabil, Iran*

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Abstract. Various studies have been performed to coordinate robots in transporting objects and different artificial intelligence algorithms have been considered in this field. In this paper, we investigate and solve Multi-Robot Transportation problem by using a combined auction algorithm. In this algorithm each robot, as an agent, can perform the auction and allocate tasks. This agent tries to clear the auction by studying different states to increase payoff function. The algorithm presented in this paper has been applied to a multi-robot system where robots are responsible for transporting objects. Using this algorithm, robots are able to improve their actions and decisions. To show the excellence of the proposed algorithm, its performance is compared with three heuristic algorithms by statistical simulation approach.

Keywords: multi-agent system; multi-robot coordination; multi-robot transportation; task allocation; auction mechanism

1. Introduction

Transportation by robots is one of the significant challenges in today's modern world (Wawerla 2010). For much of aspects, this task can be considered as a distributed task (Zheng 2009). Hence, nowadays use of a group of robots has attracted much attention in this field. Exploiting group of robots can facilitate transportation of goods, which is a complex problem and sometimes can be impossible to be performed by a single robot (Ljesnjanin 2009). Multi-robot systems are interpreted as multi-agent systems (MAS) those have got advantages such as fast responsibility, reliability, low cost, high levels of flexibility and extensibility (Sycara 1998). According to these advantages, it is obvious why nowadays in many applications, single-agent systems have been replaced by multi-agent systems (see Zlot and Stentz 2005, Kalra 2006, Gerkey 2003, Lee 2010, Jonban 2015) as examples). Nevertheless, there are some difficulties in this context that the most of them is related to allocate task in order to create coordination among agents (Gerkey 2003). Various methods have been proposed to solve these challenges. One category of these methods is

∗Corresponding author, M.Sc., E-mail: m-selselehjonban@iau-ahar.ac.ir
[a]Professor, E-mail: akbarimajd@uma.ac.ir
[b]M.Sc., E-mail: m-hassanpour@iau-ahar.ac.ir

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