Project No.	Project Title
2021-01-096	Service Oriented Multi-Agent Optimization

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Dynamic Multi-Agent Optimization Problems (MAO) have realistic applications in environments where autonomous entities are used. These include the coordination of autonomous vehicles defending borders and task allocation for emergency responders. Such applications aim to satisfy a global objective and are challenging to model and solve because of their many temporal and spatial constraints as well as their dynamic nature. The Task-Allocation Problem is a MAO in which there are heterogenous agents and tasks. The agents must tend to the tasks while attempting to increase utility by arriving early and working efficiently in cooperation with one another. A solution to the problem is a schedule for each agent, with aim to maximize the team's global utility.

A convenient way to solve such problems is by modelling them as a Distributed Constraint Optimization Problem (DCOP) as it allows for the use of the many existing DCOP algorithms to find solutions to the problem. However, while analysing this type of problem we revealed a structure that the standard DCOP model is not suitable for representing. Agents are divided into two sets, one including service providing agents while the other set includes agents representing service requiring tasks. Moreover, agents from one set interact only with agents of the other set, so the structure of the graph representing this problem is bipartite.

In recognizing this limitation of the DCOP model, we propose a Distributed Service Oriented Multi-Agent Optimization Problem (SOMAO). This model is designed for representing a variety of problems that fall into the category of MAO, where there is clear distinction between agents providing services and agents requesting services. The model contains a set of service requesters and a set of service providers, with a goal of creating schedules for the service providers while maximizing the utility for the service requesters. Each service provider knows of service requesters in its vicinity and vice-versa. Besides the advantage of having two types of agents, providing service and requesting service, which DCOP does not include, this structure allows the agents to address dynamic changes in the problem in a more modular way, e.g., if a service providing agent disappears, the service requesting agents can adjust their requests for service providing agents accordingly.

Future work will include designing algorithms that are fit to solve SOMAO, aiming to create self-stabilizing algorithms that are resilient to dynamic changes. As part of this process, we will experiment first with existing algorithms from the domain of bipartite graph matching, using several utility types and challenged by differing dynamic changes.

Keywords: Multi-Agent Systems; Multi-Agent Optimization; Distributed Constraint Optimization; Task Allocation.