A Decommitment Strategy in a Competitive Multi-Agent Transportation Setting

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Extended Abstract

Decommitment [1, 2] is the action of foregoing of a contract for another (superior) offer. It has been shown that, using decommitment, agents can reach higher utility levels in case of negotiations with uncertainty about future prospects. In this paper (originally published at AAMAS-03 Workshop on Agent-Mediated Electronic Commerce V (AMEC-V), 2003 Melbourne, Australia), we study the decommitment concept for the novel setting of a large-scale logistics setting with multiple, competing companies. Orders for transportation of loads are acquired by agents of the (competing) companies by bidding in online auctions. Using computational experiments, we find significant increases in profit that scale with the size of operations and uncertainty of future prospects when computerized agents can decommit and postpone the transportation of a load to a more suitable time . The observed profit margins in the experiments are significant from the perspective of the transportation sector where a 4% profit is considered exceptional. For example, the average profit margin before taxes for the Dutch road transport sector (from 1989 to 1999) was only 1.6% [3].

We observed in the computational experiments that decommitment of a load occurs predominantly when trucks are close to filling their maximum capacity. When few loads are available, the loads are almost all picked up and transported. If the availability increases, the (positive) effect of decommitment then increases, until the trucks reach their capacity limits. In the case of an excess of cargo, the added value of decommitment decreases as the tasks which are needed to fully utilize the remaining capacity of an agent are often available. Hence, we hypothesize a decommitment strategy is most beneficial when a truck is close to reaching its maximum capacity and has a limited number of extra tasks to choose from. We believe this is a general result for an agent capable of doing multiple tasks in parallel. This hypothesis must be kept in mind when evaluating whether to apply a decommitment strategy.

Figure 1 shows the profits made by a company (with and without the use of a decommitment strategy) as a function of the number of depots on the grid

where loads stochastically appear in the course of a day of operations. The

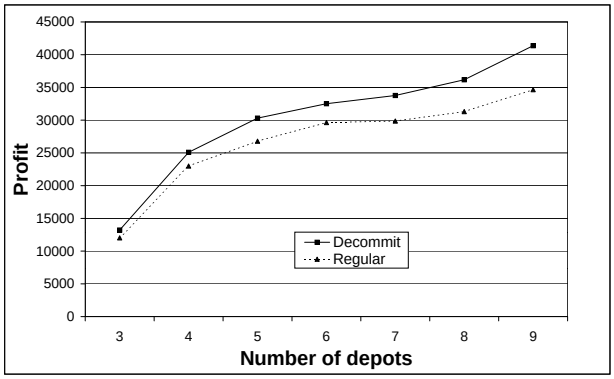

Figure 1: Profits made by a company (with and without decommitment) as a function of the number of depots on the grid.

positive effect of decommitment on a company's profit increases as the grid becomes more densely filled and the world becomes more difficult for agents to accurately predict. Results for more complex scenarios (more competing companies, more trucks per depot, prices more dependent on weight of the load, etc ...) show similar trends such that impact of a decommitment strategy increases in importance with the complexity of the world.

It is also important to note that the use of decommitment by one company can decrease the performance of the non-decommitting companies. This loss can amount up to half the increase in profit of the company who uses a decommitment strategy. This effect is of importance when the margin for survival is small and under-performing companies may be removed from the field.

For specific applications beyond that of our model and for novel areas, the added value of decommitment, and the circumstances where it can be applied successfully should be studied further. However, based upon our computational experiments, we hypothesize that the positive impact of a decommitment strategy increases with the complexity of the operating domain, as it then becomes of greater importance to have the opportunity to roll-back a previous sub optimal decision [2].

References

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