Multi-Robot Task Allocation

Multi-robot Task Allocation (MRTA) problems seek to allocate tasks to robots such that the cost to complete all tasks is minimised.

Many variants are NP-Hard [1].

Sequential Single-Item Auctions are commonly used to find solutions with bounded costs [2].

When calculating bids, robots may exploit private knowledge of currently assigned tasks.

As each robot seeks to minimise their local cost, certain tasks may be undesired by all robots and subsequently have a high completion cost.

Identifying Undesired Tasks with Collective Preferences

In most auction schemes, by design, robots bid for tasks with low costs.

As tasks with high costs receive few bids, the costs to complete unallocated tasks may increase further, relative to each robot’s other task commitments.

We ensure robots bid on all tasks and analyse all bids for each task to calculate an aggregated task cost dispersion value.

The task cost dispersion value measures the collective desires of all robots for each task.

Tasks with high task cost dispersion values are considered undesired.

Allocating undesired tasks before low cost tasks reduces the overall cost to complete all tasks.

Experiments

10 robots and 60 tasks requiring allocation. Tasks were either locations to be visited or parcels to be collected and delivered.

Five aggregation metrics for calculating Task Cost Dispersion values evaluated.

Compared to standard SSI auctions and SSI with regret clearing.

Average and Mid-point metrics produced lowest cost solutions. Results were strongest in problems with tasks requiring pickup and delivery.

Conclusions

Calculating task cost dispersion value ensures tasks collectively undesired by all robots are allocated before tasks more strongly preferred.

Empirical results show this lowers the team cost for the MiniMax team objective compared to SSI auctions.

References
