### The Any-Com Approach to Multi-Robot Coordination

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**Overview**

Multi-robot coordination algorithms that utilize available communication and are robust to communication failure.

- Find a suboptimal solution, refine as communication permits.
- Collaboration divides computational effort among $n$ robots.
- Graceful performance decline relative to % packets dropped.
- Useful when less-expensive incomplete methods fail.

**Distributed Random Tree**

Each robots searches the configuration space using an any-time random tree.

Union of all trees is itself a tree, $O(n)$ times larger, that the team collectively explores.

**Partial Solution Sharing**

Intermediate solutions are shared with the rest of the team as they are found.

Partial solution sharing also lets all robots improve the best known solution.

**Example 1: Multi-Robot Navigation**

6 robots in both simulated and real environments. Evaluation vs. state of the art centralized algorithms: baseline (a server-client model) and solution sharing (each robot plans independently, and the team uses the best result).

**Example 2: Multi-Robot Task Allocation**

$n$ robots are deployed to $m$ goals. Each robots $\rightarrow$ goals mapping is a unique navigation problem. The best solution over all mappings is desired. Each robot works on a different robots $\rightarrow$ goals mapping. Partial solution sharing is used for pruning, but partial solutions cannot be extended by other robots since they correspond to different navigation problems. 6 robots are used in a simulated environment as a proof-of-concept.

**Results**

- Significantly outperforms the other centralized algorithms ($p < .0002$).
- Finds similar quality solutions in a fraction of the time.
- Packet drop rates as high as 96.8% have little affect on performance.

**Conclusions**

- Any-Com lets robots pool resources to solve complex multi-robot navigation and task allocation problems.
- Any-Com enables distributed and collaborative computation, even in harsh (i.e. realistic) communication environments.