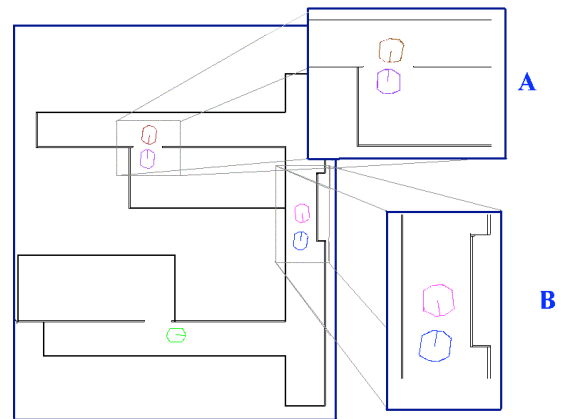
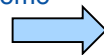


Aggression proportional to task investment can improve group efficiency

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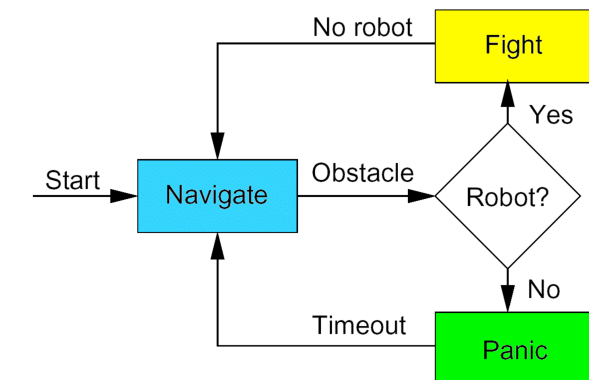
Aggressive displays solve resource conflicts

- Spatial interference is a key problem for autonomous robot teams. Territorial and avoidance strategies are not appropriate for tasks where robots must work in the same space.
- For example, in our system of ant-like trail-following and transportation [1], two or more robots trying to pass one another through a small door (A) or corridor (B) will become deadlocked.
- Symmetry must be broken to resolve the deadlock.
- Physical combat is undesirable due to risk of damage.
- Many animals have evolved stylized **aggressive displays** to resolve resource conflicts without combat.
- In previous work [2] we developed a stylized “fight” competition that could break deadlocks in favor of the most “aggressive” robot. It was shown that adding this strategy to a robot controller could significantly improve the overall group performance at the ant-like transportation task.



Choosing a level of aggression

- Previous approaches to selecting an aggression level have been shown to perform no better than random [2].
- **New approach:** use an **economically rational strategy**: the agent that has invested more work into achieving a goal has more to lose by giving in.
- Aggression is set proportional to the time spent approaching a goal.
- The performance of the new strategy is compared with that of a randomly-selected aggression level.



Results: Investment aggression performs best (so far...)

- Investment aggression enables the robot team to perform significantly better than random aggression (T-test, $\alpha < 0.05$).
- Improvement is due to robots spending more time in ‘Navigate’ (goal-finding) mode, rather than avoiding each other.
- **Future work:** We are investigating further strategies for setting aggression, and new aggressive display behaviors.

