Background

How should players in a game of World of Warcraft communicate and coordinate their actions to defeat an enemy team efficiently? A similar question is central to the design of:

- Coordinated teams of unmanned vehicles in surveillance missions.
- Distributed air traffic controls
- Automated highway

Goals

Designing & implementing efficient algorithm for:

- Constrained task allocation within teams: who should attack whom?

- Systematically constructing decentralized state feedback control laws for linear systems

Fundamental Questions/Challenges

The design of structured/distributed decision mechanism is typically an NP-hard problem.

Research Plan

Overall idea is to use relaxation methods: replace original problem with an efficiently solvable one whose solution can be proved to be a good approximation of original problem

<table>
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<tr>
<th>Problem</th>
<th>Mathematical formulation</th>
<th>Relaxation</th>
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<tr>
<td>Task allocation</td>
<td>$\min \sum a_i \leq 1 \forall j$</td>
<td>Dead End</td>
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<tr>
<td></td>
<td>$\sum a_i \geq 1 \forall i$</td>
<td>Heuristics</td>
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<td></td>
<td>$\sum a_i h_j - H_{ij} \leq 0 \forall i$</td>
<td>Linear Programming</td>
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<tr>
<td>$a_{ij} = {0,1}$</td>
<td>Integer Programming</td>
<td>Family of semi-definite programs</td>
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Research Results

Task Allocation problem:
- Recursive method to generate the admissible sets of players for each monster.
- A necessary condition to be satisfied and reduced to the set-partitioning problem.

Decentralized feedback control design:
- Understanding the theoretical underpinnings of semi-definite programming relaxations for polynomial matrix inequalities using the moment method of [1]
- Realized that no good relaxation code for the matrix case is available as part of the freewares Sedumi/Gloptipoly.

Future effort will be to implement such a code.