Overview & Contributions

- Modelling approach for task planning for mobile service robots in everyday environments
- Approach for synthesising optimal policies for Markov decision processes, with co-safe temporal logic specifications that are not satisfiable with probability 1
- ROS integration

Addressing Partial Satisfiability

- Novel additions represented as pink arrows
- Progression function formalises notion of “doing as much as possible”
- Product pruning removes states from where no more progress can be achieved, ensuring convergence of value functions corresponding to each objective
- Nested value iteration, a generalisation of value iteration to handle prioritised objectives is introduced to synthesise policies that, in decreasing order of priority:
  1. Increase robustness by maximising probability of success
  2. Do “as much as possible” by maximising progression towards the goal, even when it becomes unachievable
  3. Improve efficiency by minimising expected execution cost

Evaluation

- #Offices | S | $\delta_M$ | $|S_\phi|$ | $\delta_M,\phi$ | NVI | VI
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<thead>
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<tbody>
<tr>
<td>6</td>
<td>10,206</td>
<td>49,572</td>
<td>33,129</td>
<td>169,002</td>
<td>−3.3 sec</td>
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<tr>
<td>8</td>
<td>120,285</td>
<td>632,043</td>
<td>333,984</td>
<td>2,095,956</td>
<td>−27 sec</td>
</tr>
<tr>
<td>10</td>
<td>1,338,444</td>
<td>7,223,661</td>
<td>4,408,263</td>
<td>24,038,046</td>
<td>−7.5 min</td>
</tr>
</tbody>
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“Visit locations 1, 6, and 18, while avoiding location 0.”

$(\neg v_0) U v_1 \land (\neg v_0) U v_6 \land (\neg v_0) U v_{18}$

Discussion

- Used for task planning of a mobile service robot, with meaningful probabilistic guarantees on task execution
- Allows flexible goal specification
- Probabilistic guarantees can be used to inform end users, or other software components (e.g., execution monitor, or higher level task scheduler)

Further Work

- Uncertain models
- Multi-robot systems
- Multi-objective reasoning