CPS Small - Collaborative Research: Distributed Coordination of Agents For Air Traffic Flow Management

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Motivation

- Tight coupling between between computational algorithm and physical air traffic system is critical to safety and performance
- Traditional algorithms neither robust nor flexible
- Multiagent systems ideally suited to this problem

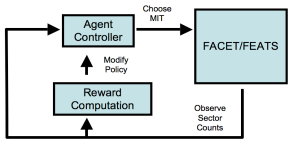
Broader Impact

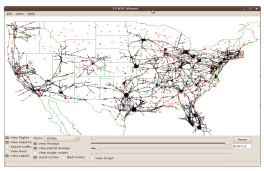
- Reduce Congestion:
  - $41 billion (in 2007)
  - Improved flight experience
- Education:
  - New courses in Cyberphysical systems
  - Grad student mentoring

Objectives

1. Develop fast estimation simulator
2. Optimize flow control and derive new agent rewards
3. Demonstrate effectiveness on real world data

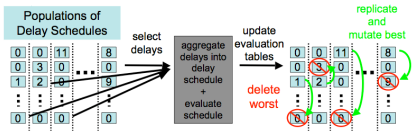
1. FEATS Simulator



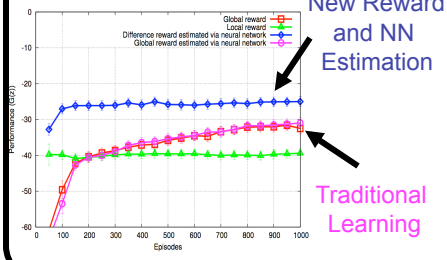


- Faster than FACET
- Good air traffic flow estimation accuracy
- Scales to full US airspace

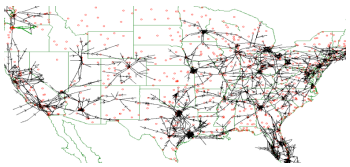
2. Agent Rewards



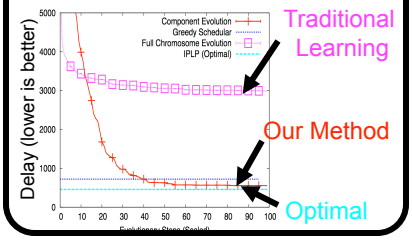
- Component learning/evolution allows for fast learning and high performance in large problems
- Neural net reward estimation allows flexibility and high performance



3. Real World Data



- Full US Airspace optimized at once (5,910 aircraft)
- Near optimal performance
- Solution robust to uncertainty



Conclusions

- Multiagent decomposition ideally suited to air traffic flow problems
- Reward estimates and simulation improve and speed up learning
- Agent architecture scales to large control problems

References

- *Robustness of Two Air Traffic Scheduling Approaches to Departure Uncertainty*. Adrian Agogino and Joey Rios. Digital Aviation and Systems Conference. (To appear Oct. 2011)
- A Multiagent Approach to Managing Air Traffic Flow. Adrian Agogino and Kagan Tumer. Journal of Autonomous Agents and Multiagent Systems. 2010
- *Component Evolution for Large Scale Air Traffic Optimization*. Adrian Agogino. Genetic and Evolutionary Algorithms Conference 2010 (extended abstract)