Embedded and Cyber-Physical Systems

- Projects-

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Intersection controller

Intersection controller: setup

- Control of traffic lights at an intersection (+) based on sensing incoming and outgoing vehicles
- Each incoming lane has two sensors (e.g., induction coils)
  - Sensor for vehicles approaching the intersection
  - Sensor for vehicles about to enter the intersection
- Each outgoing lane has a sensor for detecting vehicles leaving the intersection
- Vehicles can be autonomous or human-driven
- Autonomous cars can communicate among them

Intersection controller: requirements

- DES models of vehicles and intersection
- Design controllers for conflict resolution among autonomous cars
- When no human-driven vehicle approaches the intersection, traffic lights are always green
- Design a controller for traffic lights for the case where human-driven vehicles are involved
- Note: automous vehicles do obey traffic lights!
- Refine your models to timed automata
- Prove safety of designs
- Use Ptolemy II to model and simulate the system

Unmanned Aerial Vehicles Flight Formation

UAV control: basic setup

- A group of UAVs moves in 3D space along linear trajectories
- Each UAV moves independently or follows another UAV
- A ground coordinator sends messages via a data link with flight plans for the UAVs
- A flight plan is a sequence of points in 3D with timestamps
- A UAV stops when reaching the final point of its flight plan, unless it has received a new flight plan or it has joined a formation
- Every UAV periodically broadcasts its position and velocity vector

UAV formation requirements

- A formation request specifies at least a target point to be reached by the leader and the type of formation (including the number of UAVs)
- Examples of formations: 3-V, 5-line, 7-column
- A formation request may specify the full UAV formation or not
- If not, then some of the UAVs must achieve the formation autonomously
- Start with 2D, then move to 3D
- Optional: use the GR domain for 3D visualization