Modal Models in Vehicle-Vehicle Coordination Control

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Vehicle-Vehicle Coordination Control

- Part of the MoBIES Automotive Open Experimental Platform (OEP)
- Used on vehicles in an intelligent vehicle highway system
  - Platoon formation
- Goals
  - Maintain safety
  - Reduce traffic delay
  - Maximize fuel efficiency
  - Give passengers a comfortable ride

Picture obtained from http://vehicle.me.berkeley.edu/mobies/vehicle/
Control Modes in Vehicle-Vehicle Coordination

- The controller works in different modes due to:
  - Operational requirements
    - Tracking
    - Collision avoidance
  - Quality of communication among vehicles
    - Reliable real-time update of speed/distance among neighboring vehicles
    - Complete loss of inter-vehicle communication
  - Various failure conditions, etc.

- A modeling paradigm is needed for designing and validating modal controllers
Motivation of Modal Models

- Finite state machines (FSM) are used extensively to describe modes and transitions
  - Formal analysis and verification methods available

- FSMs are in general not practical to describe the control algorithms
Motivation of Modal Models, Continued

- FSMs need to be hierarchically composed with other computational models.
The composition may involve multiple computational models.
Modal Models in Ptolemy II

- Leverage the Ptolemy II infrastructure that supports hierarchical heterogeneity
- Capable of modeling modal systems that involve various models of computation, such as continuous time (CT), discrete event (DE), Giotto, and synchronous dataflow (SDF)
A Modal Model of the MoBIES Vehicle-Vehicle Automotive OEP Problem

- Created by Professor Edward A. Lee, based on a formulation from the U-Penn MoBIES team

The leading car has a modal controller with two modes: merge and track.
Vehicle-Vehicle Model, Continued
For the track mode, the model is similar but with different parameters.