CAREER: Multi-Resolution Model and Context Aware Information Networking for Cooperative Vehicle Efficiency and Safety Systems

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Motivation

Connected vehicles rely on V2V networks. Scalability is one of the main challenges, preventing rich collaboration and sensor information sharing.

Proposed approach:

replace *data communication and networking*
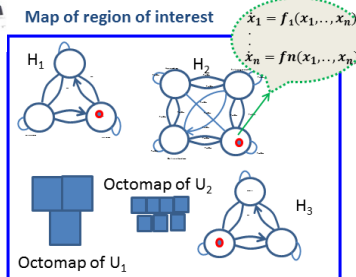with *model communication and networking*

Model-Based Communication relies on exchange of models and model updates instead of raw sample data.
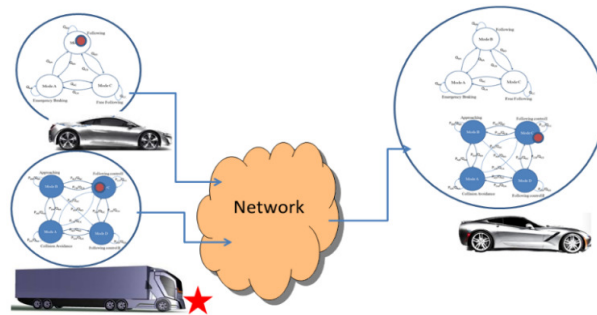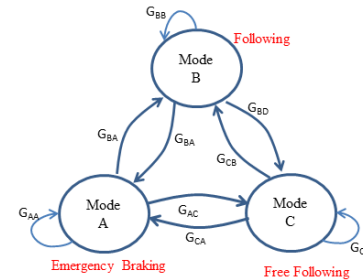
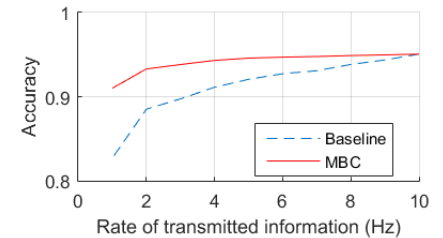## Example Application: Forward Collision Detection

HV   RV

Example application of **Model Based communication (MBC)** : If vehicle movement model is communicated and updated, instead of vehicle position information, higher accuracy of error detection is possible at much lower communication load levels.

Map of region of interest

$$x_1 = f_1(x_1,..,x_n)$$
$$\dot{x}_n = fn(x_1,..,x_n)$$

H_1 H_2 H_3

Octomap of U_2

Octomap of U_1

Following

Mode B

G_{BB} G_{BA} G_{BD} G_{BA} G_{CB}

Mode A G_{AC} Mode C
G_{AA} G_{CA} G_{CC}
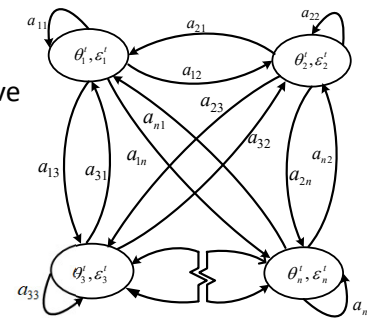
Emergency Braking   Free Following

Example of vehicle movement model

Accuracy vs Rate for Baseline and MBC methods, assuming PER =0

Example Application: Cooperative Adaptive Cruise Control

Learn and update model : Use a switched system structure such as HMM + ARX hybrid system.
Control: Use exchanged models in model-predictive CACC controllers
Result is an order of magnitude improvement in spacing error in CACC

5 vehicle platoon

conventional CACC

MBC MPC - CACC