Adaptive Reachability Analysis to Safe Driving of Autonomous Vehicles

Dr. Di Liu

Cyber-Physical Systems Group
Technische Universität München

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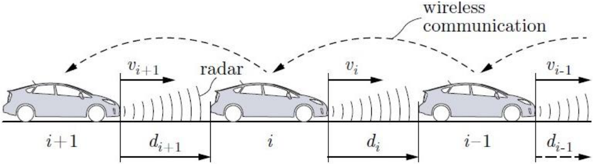
Motivation

Cooperative automated vehicles promised to solve traffic problems by autonomously forming *platoons* and by adaptively merging/splitting according to traffic conditions [1]



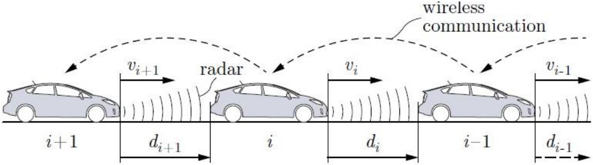
Two main platooning technologies proposed in the literature:

- Adaptive Cruise Control (ACC): only onboard sensing (radar, tachometer, etc)
- Cooperative Adaptive Cruise Control (CACC): onboard sensing + wireless communication (e.g., with preceding vehicle)

[1] K. C. Dey, L. Yan, et al. 'A review of communication, driver characteristics, and controls aspects of cooperative adaptive cruise control (CACC)' IEEE T-ITS, 2015

Control designs

Despite the word adaptive being used in ACC or CACC, most standard designs are non-adaptive.



Two main platooning technologies proposed in the literature:

- Most designs are linear: the control gains are fixed;
- Most designs are adaptive: the control gains can change in time according to an adaptive law.

Unfortunately, any adaptive controller is nonlinear, which is difficult to analyze.

Two main goals

1) Formal methods proof that adaptive designs are superior to linear

- Formal verification of an adaptive design (specifications: safety, disturbance rejection) and comparisons with a linear design;
- The formal verification should take into account the presence of uncertainty (when an adaptive design is expected to have benefits over a linear design);
- ...

2) Propagation of benefits

- Consider more predecessor-follower pairs (instead of only one): will the benefits above increase (or decrease, or remain constant)?
- With communication failures that require switch between CACC and ACC, would an adaptive design still be beneficial over a linear design?
- ...

Contact

Requirements

- High motivation and independence
- Good understanding of Matlab
- Good knowledge of CORA
- Knowledge of control theory is a plus

Interested or further questions?

Contact:
Di Liu
Email: di.liu@tum.de
Homepage: https://www.ce.cit.tum.de/air/people/di-liu/