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„On the Design of Synchronous Traffic Protocols for Intelligent Intersections“

Summary of Findings

Confining strategies for intelligent intersections to a specific type of traffic or infrastructure greatly restricts their applicability in the real world. To alleviate this, this thesis proposes several techniques with the goal of bridging these gaps and making these protocols applicable to a wider range of settings. Specifically, this thesis proposed a probabilistic modeling of communication reliability to reduce deterministic pessimism, as well as three traffic protocols: i) SV-LTR to increase space efficiency, ii) PB-LTR to apply the concept of platooning to intelligent intersections and iii) FlexS-TP to increase flexibility towards traffic composition.

Reducing Deterministic

Pessimism Ensuring communication reliability between vehicles and the corresponding road side unit (RSU) requires knowledge of the maximum number of vehicles in the system to assess interference. By using a realistic, probabilistic vehicle length distribution instead of assuming longest possible vehicle allows for a reduction in deterministic pessimism and the following overdesign by using stepwise, probabilistic worst cases.

Infrastructure-Agnostic

Design Treating extraordinarily large vehicles as exception instead of the norm leads to an uncoupling of the traffic protocols sector size S from the actual traffic, as introduced in the space-efficient traffic protocol SV-LTR and also used later in PB-LTR and FlexS-TP. Instead, the existing infrastructure now provides the sector size S , allowing for infrastructure-agnostic design where the traffic protocol can be applied to any given infrastructure with the existing geometry parameterizing the protocol, alleviating the need for great modifications of existing intersections, while providing competitive or even greater throughput.

Platooning for Well-Behaved Traffic

The traffic protocol PB-LTR extends SV-LTR's single-vehicle maneuvers to platoons consecutively performing the same maneuver, enabling shorter inter-vehicle distances and reducing downtime from maneuver transitions. To ensure all vehicles eventually cross the intersection, a maximum blocking time regularly enforces maneuver changes, guaranteeing fairness across all directions. Under well-behaved traffic, PB-LTR can further increase throughput.

Increasing Flexibility towards Traffic Composition

By maintaining a synchronous strategy at heart, but scheduling vehicles on a vehicle-by-vehicle basis while still allowing for situational synchronicity, the traffic protocol FlexS-TP can harness both the benefits of synchronous traffic protocols for well-behaved traffic, as well as the flexibility of asynchronous traffic protocols under randomized traffic, achieving substantial throughput in both settings - combining the best of asynchronous and synchronous strategies.

Öffentliche Verteidigung im Rahmen des Promotionsverfahrens

“On the Design of Synchronous Traffic Protocols for Intelligent Intersections”

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Technische Universität Chemnitz, Straße der Nationen 62, Raum: A12.336 (alt: 1/336)

Alle interessierten Personen sind eingeladen.