

2.3 Crash Avoidance

Whenever a vehicle receives a Cooperative Awareness Message (CAM) it calculates the intersection collision probability as proposed in [10]. If the calculated intersection collision probability exceeds the threshold of 50%, the vehicle is choosing one of the following reactions:

1. If it is the vehicle which is closer to the potential collision point it will continue with the same speed.
2. Otherwise it will perform a full stop immediately with the maximum deceleration rate.

As we will see in the next Section, this does not allow us to avoid 100% of all CRASH situations. Therefore, more effort is needed to develop advanced reaction controllers which might even negotiate the reaction with other vehicles.

3. IMPACT OF COMMUNICATION

We simulated 250 different dangerous situations at an X-intersection out of which 175 resulted in CRASH when no autonomous reactions have been triggered. When enabling the autonomous reaction controller, the number of avoided crashes depends on the communication protocol or strategy. Since the controller is not able to avoid all crashes even with perfect knowledge, we first performed simulations with perfect knowledge and it turned out that the controller is able to prevent crashes in 157 cases or 89.7% of CRASH intersection approaches.

To make the scenario interesting from a communications point of view, we placed 30 vehicles within the communication range to cause background communication by exchanging CAMs with the same communication protocol as the two dangerously approaching vehicles. With TRC as communication primitive, the controller was able to prevent 132 crashes which translates to 84.0% of avoidable CRASH situations. When employing DynB, the controller was able to prevent 139 crashes which corresponds to a crash prevention rate of 88.5%. So even for this relatively simple scenario, the difference of 7 crashes is non-marginal.

4. CONCLUSION AND FUTURE WORK

In this paper we presented a model for simulating CRASH situations as well as a simple autonomous controller to showcase the impact of communication protocols on road traffic safety. We compared the impact of two state of the art communication protocols for IVC. A more detailed simulation study regarding the impact of road traffic safety as well as a solution to the fairness dilemma of current congestion control mechanisms has been published in [8]. However, in that work we used the *unsafe time* that a vehicle experienced during the last three seconds before a crash, as a safety metric.

In future the presented simulation framework can be used in conjunction with any realistic autonomous controller or a driver reaction model to evaluate communication protocols and strategies for intersection assistance applications. For the future evaluations we suggest the use of the following more comprehensive safety metrics:

- *Percentage of avoided crashes*
- The *reduced collision speed* and the *reduced maximum percentage of possible overlap*, might serve together as impact reduction metric, for the remaining crashes.

5. REFERENCES

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