Rear-end collisions occur when the front bumper of a car strikes the back bumper of its leading car. According to the National Highway Traffic Safety Administration (NHTSA), rear-end crashes are the most frequently occurring type of collision. They account for approximately 29% of all crashes and result in a substantial number of injuries and fatalities each year, making them the most common type of accident. In the U.S. rear-end accidents cause 950’000 injuries and 2’000 deaths each year. NHTSA also claims that 90% of rear-end accidents are caused by delay in driver recognition and could be prevented if the driver would become aware of the situation just one second earlier. A considerable amount of research has been conducted to try to prevent such accidents by integrating a Collision warning systems (CWS) on-board of the rear vehicle. CWS are safety systems designed to avoid a potential collision or reduce the severity of an accident by warning the driver through auditory and/or visual signals. The equipped vehicle uses both proprioceptive sensors (to estimate its speed, acceleration or tire friction) and exteroceptive sensors (to estimate range or range rate) to compute an assessment of potential collision threats in real-time. When the CWS detects a threat, the driver is usually warned through auditory and/or visual signals. This paper conveys the idea that until all vehicles are equipped with such systems, it is important to consider not only intelligent rear vehicles but also intelligent front vehicles. To the best of our knowledge, no such approaches have been implemented on a leading (front) vehicle.

Most current research focuses on either warning or overriding the rear vehicle driver to take evasive action (e.g. braking, steering). We would like to propose a new collision warning (called Tlsa), inspired by [17], informing the front driver that he will be part of a rear-end collision. We will consider the human reaction time so that the evasive action (e.g. pressing the throttle) can be taken by the driver to successfully avoid the collision.

CWS are safety systems designed to avoid potential collisions or reduce the severity of accidents in the automotive industry. They monitor the dynamic state of traffic in real time, by processing information from various proprioceptive and exteroceptive sensors and assess the potential threat level to decide if a warning should be issued to the driver through auditory and/or visual signals. Several measures have already been defined for threat assessment and various CWS have been proposed.

A new collision avoidance warning system (Tlsa) for lead vehicles in rear-end collision is proposed and discussed throughout the paper. Tlsa is to the best of our knowledge, a new approach on warning systems focused on the lead vehicle. Its time-based approach is coherent with human judgement of urgency and severity of threats. It directly quantifies the threat level of the current dynamic situation for the required evasive action (i.e. maximum acceleration) to be applied. Furthermore, warning criteria are proposed considering driver reaction times to artificial warning signals. Its effect on decreasing the severity of the accident is studied. Finally, the reliability of the system is tested in simulation.

\[ Tlsa \text{ curves depending on range and range rate.} \]