

# Exploring appropriate alarm timing for a driver-adaptive forward collision warning system

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## Abstract

Determining appropriate alarm timing is important for developing an effective forward collision warning system. Using a high fidelity driving simulator, a driver adaptive alarm that is triggered based on individual driving styles was investigated. Two types of alarm timing were considered in this research: (1) timing such that an alarm is given at the time of ordinary accelerator releasing, and (2) timing such that an alarm is given at the time of ordinary brake implementation. The experimental data for eighteen participants were analysed in order to evaluate the effects of changing alarm timings on driver subjective ratings of trust in an alarm and on driver's timing of releasing the accelerator and implementing the brakes. The results indicate that, overall, both alarm timings are acceptable for the participants from the viewpoint of trust. Driver behaviour was not greatly affected by the presentation of alarms, and drivers avoided collisions effectively. However, for drivers who have particular driving styles, e.g., drivers who tend to implement the brakes very early or very late, simply adapting the alarm timing to brake implementation timing may impair the driver's trust in the alarm. Potential applications of these results include methods for setting alarm timings for driver adaptive forward collision warning systems.

## Introduction

The reduction of traffic accidents is an important goal, and rear-end collisions are one of the most common types of accident. Forward Collision Warning Systems (FCWS) may be of great potential benefit to drivers who are not paying sufficient attention while driving, and these systems may reduce the number of traffic accidents (Alm and Nilsson, 2000; Ben-Yaacov et al., 2002).

It is likely that drivers will implement situational recognition, decision-making, and action implementation based on their own intention to avoid risky events. If there is a mismatch between the intended action by drivers and the alarm presentation, then the driver and the FCWS may not agree on a course of action. More specifically, the driver may be annoyed by alarms that do not correspond with their plans to