

## **Title: Experimental evaluation of distributed visual warnings for ADAS**

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The most common human machine interface of today's Advanced Driver Assistance Systems (ADAS) is based on warnings. Thus, the optimal design of ADAS warnings is one of the crucial aspects for the effectiveness and acceptance of ADAS. General design requirements state that warnings need to be (at least) noticed, understood and accepted. Furthermore, time restrictions require warnings to be processed by drivers in a very quick and intuitive way in order to trigger the correct response in time. Uni-modal warnings (same modality of warning and hazard) have been shown to elicit quicker responses than cross-modal warnings (different modality of warning and hazard) while multi-modal warnings have been shown to perform in a the most robust way across different situations. Similarly, directional cues such as stereo sounds are superior to non-directional stimuli if the additional spatial information contributes to the intuitiveness of the warning.

The Vehicle Interaction Team at Fraunhofer IAO designed a series of experiments in order to evaluate a new approach for displaying visual warnings, especially for late stages of the warning process. A total of 6 visual warning indicators are placed at specific positions in the vehicle interior in order to guide the driver's visual attention to the correct direction of a particular situation. This method is integrated in a multi-modal warning strategy using also sounds and graphics on a central display. This warning strategy has been conceptualised for two collaborative ADAS within the European research projects SAFESPOT and WATCH-OVER. Dependent variables are related to driving performance, visual glance behaviour and subjective ratings of the test subjects. The experiments are planned to be finished by mid February. Hypotheses are that visual and directional warnings can improve the effectiveness, efficiency and acceptance of ADAS warnings since they are supposed to facilitate the correct response – looking very quickly into the direction of the hazard – due to the uni-modal and directional character. Results will reveal if this potential benefit of spatially distributed visual signals can be demonstrated in the experimental setup.

The concept, hypotheses and methods have not been published in any other public paper so far.



Example of a spatially distributed visual warning (red light in left window) vs. central visual warning (on centre display).