

# Haptics research at Daimler AG

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The following article provides a brief overview of applied haptics research at Daimler AG. In order to meet the need to impart knowledge to students and do justice to the nature of this textbook greater attention will be paid to the objectives, the research object and methodology instead of reporting detailed results of specific studies. The purpose of this is to illustrate the research methods and enable their application to relevant problems.

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## Objectives of haptics research at Daimler AG

In many cases it is assumed that driving a vehicle is largely based on visual perception and that the majority of information processed is of a visual nature. However, one must ask whether this human distance sense is not being overestimated for certain areas of driving and what importance the sense of touch, a human close sense, has with regard to driving. In order to drive a vehicle the driver absorbs many different items of information from the environment and from the road *via* the oscillations and vibrations of his vehicle. He feels the condition of the road and the dynamic response using the seat and steering wheel when driving. At the same time he drives his vehicle using the controls: he moves the steering wheel sensitively, enters route information into the navigation system, regulates the air-conditioning, presses the accelerator and brake with his foot, opens and closes the glove compartment or hatch, etc. The sense of touch is therefore used for sensori-motor coordination [1] of driving

and operating activities at the 'points of contact' between the human being and the vehicle. In order to ensure safe, accurate and precise operation, controls are necessary which are optimally adapted to the quality of human information processing, and particularly to that of the sense of touch. As a result, the *first objective* of haptics research at Daimler AG is to ensure ergonomic, reliable operation which guarantees safe and comfortable driving of the vehicle.

The *second objective* of haptics research focuses on perceived quality. Nowadays customers do not just expect a functional vehicle. The vehicle tends to be a 'work of art' which the customers perceive with all their senses. An attractive and harmonious overall picture of vehicle design and a selection of top-quality materials are absolutely essential. Consequently, questions arise like: What materials do customers regard as top-quality? What is the distinguishing feature of real leather? What do plastic surfaces have to look like if they are not to be perceived as inferior or distracting? This results in the second objective of haptics research at Daimler AG, designing controls and surface materials which give an overall impression of top quality, highlight the character of the vehicle and achieve a high level of acceptance by the customer.

The *third objective* of haptics research relates to the quality of haptics research itself. The latter has to produce valid and reliable results and specify and quantify customer requirements in detail for vehicle development. This type of haptics research is not basic research but research with a clear application. It is intended to develop top-quality products which inspire customers.

## Object of haptics research within automotive research

Haptics research chiefly concentrates on the haptics of mechanical controls (handles, flaps, lids, etc.), electric controls (switches, rotary actuators, operating levers, etc.) and areas of surface materials (leather, covers, material touch lacquers, decors and trim, etc., see Fig. 1). However, these vehicle components are 'only' the target objects of optimisation and development. The actual object of haptics research within the company is rather the assessment of customers' experiences with those vehicle components depending on their method of use and application. Sensory experience itself and the features of the sense of touch in the use of vehicle components are researched systematically.

## Methodology of haptics research at Daimler AG

Haptics research at Daimler AG is located centrally in the Customer Research Center of Group Research and it addresses issues coming from all business units. In the haptics laboratory of the Customer Research Center staff consists primarily of psychologists with specialisations in experimental and perception psychology. Owing to its cross-functional orientation the haptics laboratory is closely networked with the development, design and marketing departments so intensive interdisciplinary collaboration is guaranteed.

In order to optimise the haptics of a driver control (e.g., a switch or rotary light actuator) and basically also of surface materials, one methodological approach has proved successful. It is based on five process steps (Fig. 2).

### Phase 1: conceptual analysis of the problem

The objective of the first phase is to analyse the problem, compile existing information and struc-



FIGURE 1. S-CLASS INTERIOR WITH DIFFERENT CONTROLS AND MATERIALS

ture the content of the project. For this purpose it is necessary to understand the functional and constructional principles of controls in terms of physical engineering. Therefore, it is helpful to analyse many different types of controls, including models of other brands, to conduct technical measurements and classify them. Analysis of the force-travel characteristic plays a key role because it is crucial to haptics perceived generally (see Figs 3 and 4). In addition, research has to be conducted into perception thresholds, i.e., absolute and differential thresholds. For example, one has to investigate what differences in force level can be perceived reliably by a human being. It is the thresholds which determine the degree of detail and the dimensions of optimisation options. If information available is inadequate, a specific investigation has to be conducted into the perception thresholds.

### Phase 2: definition of customer requirements and customer-relevant criteria

With adequate technical understanding of the controls initial hypotheses can be developed determining what their haptic quality might be dependent on from a customer's point of view. In this phase the requirements must be identified which customers expect switches and materials to meet. For this purpose it is also possible to apply results of market research studies or comparative vehicle