

# Shared and cooperative movement control of intelligent technical systems: Sketch of the design space of haptic-multimodal coupling between operator, co-automation, base system and environment

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**Abstract:** The following short-paper sketches the concept of haptic-multimodal coupling between operator, co-automation base system and environment. Haptic-multimodal couplings use mainly the haptic interaction resource, e.g. the combination of hand and feet with active inceptors like active sidesticks or steering wheels, and complement this with visual, acoustic and kinaesthetic feedback. Haptic-multimodal couplings can serve as a base for shared control, and, if the co-automation has a minimum of understanding of and reactivity to the human operator, for cooperative control between operator and automation. The paper gives a brief introduction of shared and cooperative control, that can also be found in the non-technical world, and sketches the basic structure the couplings and coupling schemes. While much of the design space is yet to be explored and described more systematically, some combinations of haptic-multimodal couplings can already be applied, e.g. to the cooperative control of an intelligent vehicle. The paper briefly describes an example an automation-initiated de-coupling of the driver in case of an emergency maneuver.

*Keywords:* Driver in the loop, vehicle automation, haptic-multimodal coupling

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