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Autor(en) des Beitrags: Lorenz, L.; Fiala, D.; Spinnler, M.; Sattelmayer, T.
Abstract: Cabin heating and cooling loads of modern vehicles, notably electrically driven, represent a major portion of the overall vehicle energy consumption. Various concepts to reduce these loads have thus been proposed but quantitative experimental analysis or numerical predictions are scarcely available. Conventional 1D or zonal cabin models do not account adequately for strongly inhomogeneous cabin climate conditions. In this paper a new cabin model is presented, which delivers both temporally and spatially resolved data. The model uses a dynamic coupling algorithm including a Combust. & FlameD simulation of the cabin airflow, a model of the cabin structure and the detailed passenger Fiala Physiological Comfort (FPC) model. The coupling not only includes heat transport between the cabin air and the surrounding surfaces, but also considers important interactions with the occupants, including e.g. the release of moisture into the cabin air by respiration and sweating predicted by the Fiala Physiological Comfort model and the heat exchange between occupant body parts and solid surfaces by radiation and conduction. The coupled model was validated by an experiment conducted in a climate...
chamber with 22 human test subjects, to assess the effect of local measures such as seat heating in a cold environment on surface temperatures, thermal sensation and comfort. The performance of the coupled model and the effect of concepts to reduce the heating energy demand and enhance thermal comfort, such as a low emissivity window coating, seat and panel heating, are demonstrated as two sample test cases at cold weather conditions.

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