

## The scalable Multibody model VIRTHUMAN for future safety applications

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The virtual assessment of passive safety continues to increase its role in transport. The developers provide the virtual human body models based on real biofidelic data. These models are useful for specific application (e.g. frontal crash ODB with 40 % overlap by Euro NCAP). Today's human models are perfectly designed with professional approach to get very accurate results. Unfortunately, this approach leads to very specific models with significant costs on computational resources. The main reason of the presented Virthuman model is to provide a multi-purpose scalable human body model with sufficient accuracy in a low calculation time.

The shape of the basic Virthuman model is based on the real data from the database CEESAR. The basic Virthuman model is based on the 50<sup>th</sup> percentile human body parameters, but the whole model is smoothly scalable depending on the mass, the height, the gender and the age in a wide percentile scale. The model is developed using the multibody approach (MBS) coupled to a deformable parts to ensure the skin deformation. Individual parts of the body (as thorax, pelvis) are usually created as a single rigid body or as a conglomerate of few rigid bodies, which is connected to the skin parts. Each skin part can be compressed separately with different stiffness and damping. Due to this arrangement, the response of different tissues can be simulated. The biomechanical response is verified by validations, which are based on the data from cadaver tests. Thanks to this approach, the biomechanical response of the Virthuman model is biofidelic as the response of a real human body. Whilst the human body models and dummies are usually developed for specific collision scenarios, the Virthuman model is suitable for multi-purpose use.

The impact of the Virthuman model is focused not only on the current challenges such as passenger and pedestrian safety, but also for future multi-modal transport safety (motorcycles, autonomous cars, road-trains, electro mobility). The Virthuman model is also a suitable tool for an automatic optimization process, where optimization of safety systems and personal protective devices can be done by running plenty of optimization simulations.

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