

VIRTHUMAN – scalable multi-directional hybrid model for safety

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New biomechanical model VIRTHUMAN exploitable for virtual prototyping in the field of passive safety taking into account variety of human population is developed. The structure of the model is designed for fast simulations while achieving the results allowing detailed analysis of injury criteria. The model is created based on MBS. The MBS structure concentrates the body mass and joint stiffness. It carries rigid portions of the external surface, so called superelements, to define the external body shape. The superelements are linked to the basic MBS structure by nonlinear springs reflecting the local flesh deformation. The superelements are designed so that the positioning of the model keeps continuous surface. The reference geometry of the external surfaces is chosen from the European database CAESAR in order to be close enough to a 50%-tile dummy as far as body dimensions are concerned. The scaling methodology is based on anthropometric data measured over past thirty years and it enables automatically generate models of individuals of different height, weight, age and gender using a generator integrated into the Visual Environment. The response of the new model was validated on antropometric segments level (head, neck, thorax, abdomen and lower extremities) as well as on crash scenarios with the full scale model. The validation also concerned various directions and various energy levels with consideration of bones rupture for lower extremities. The full scale validation was performed on standard sled tests and pedestrian tests. During all validations, the model showed high computational stability for general loading and it was proved, that it is suitable for detailed analysis of injury level.