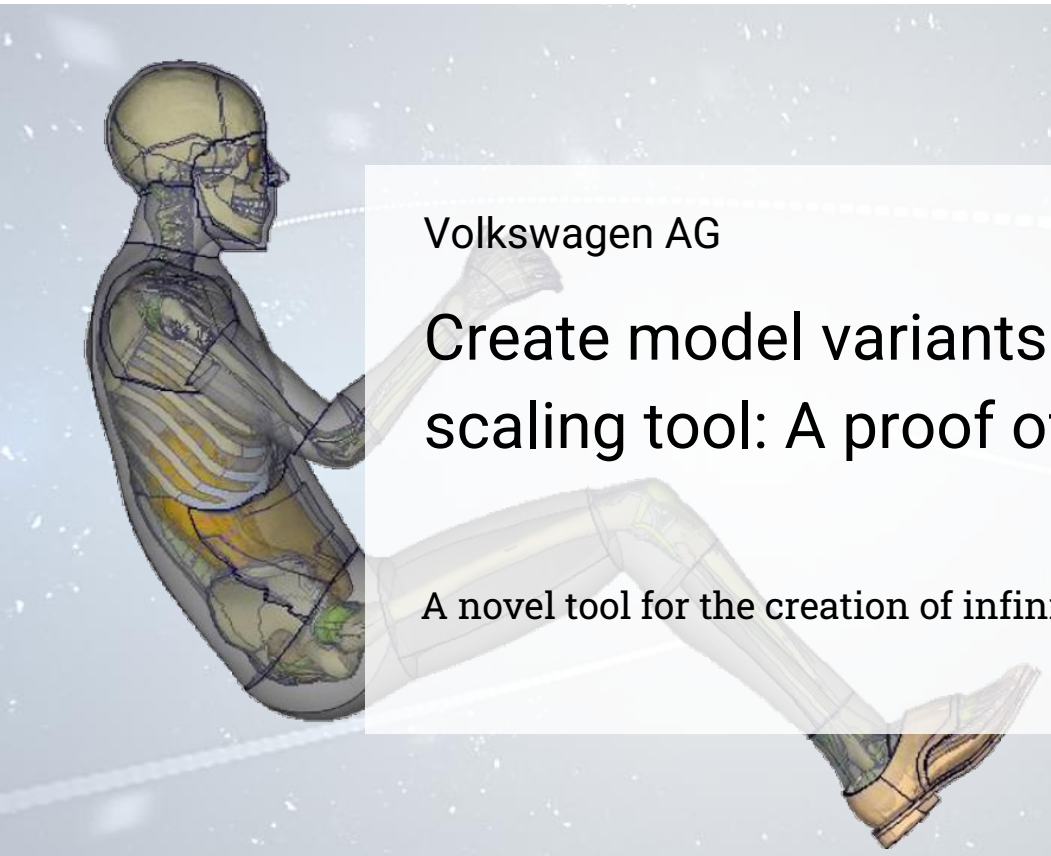
BETA
SIMULATION SOLUTIONS



Volkswagen AG

Create model variants using ANSA's scaling tool: A proof of concept

A novel tool for the creation of infinite HBM variants

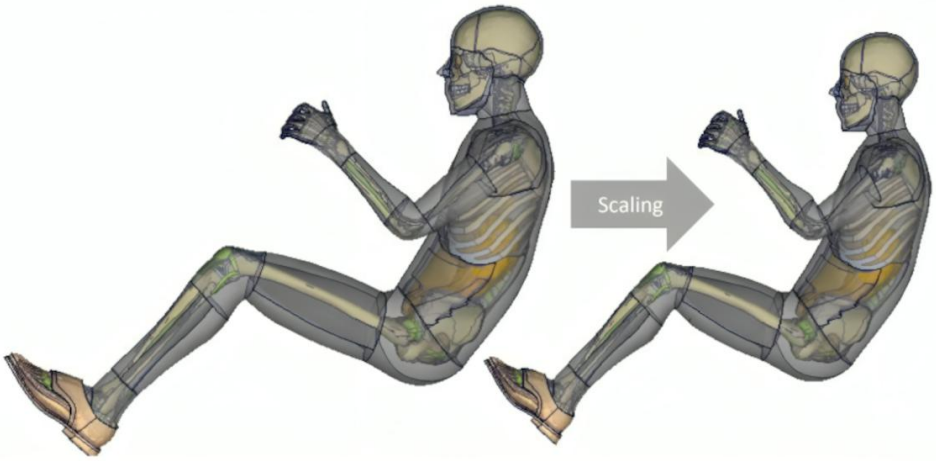
Human Body Models (HBMs) are increasingly used in research and are being integrated into car evaluation protocols, such as the Euro NCAP occupant and pedestrian protocol. Two primary types of HBMs are currently in use: the models from the Global Human Body Models Consortium (GHBMC) and the Total Human Model for Safety (THUMS) developed by Toyota. Both model types represent all major anatomical structures and have been validated against numerous experimental datasets. Each one includes models corresponding to various crash test dummies, including the 50th percentile male, 5th percentile female, and 95th percentile male.

However, this standardization limits future developments such as individualized restraint systems for individuals of different stature, or body mass. To address this issue, a higher variety of models is needed to improve restraint systems for diverse populations.

"The advanced scaling tool in ANSA introduces new possibilities for HBM modifications, enabling the full potential of future HBM supported developments in vehicle safety to be realized. ANSA's tool is not only stable and efficient but also significantly faster, making it a valuable asset for any development team."

Fenna Neumann
PhD Student, Volkswagen AG

Dr. Priti Yadav
Vehicle Safety Development Engineer, VAIVA GmbH



VW Group Modell (modified THUMS) AM50 was scaled to a smaller individual with a difference in body height of approximately 6 cm. Full body scaling matches anthropometric measurements (based on PIPER metadata) to ensure physiological results. *Size of HBMs are not to scale.

Challenge

The objective of this study is to develop and implement an automated methodology that generates a diverse range of model variants, ensuring a more comprehensive representation of the population and a better understanding of how different body types interact with safety system

Approach

The automatic and reliable generation of Human Body Model (HBM) variants is based on anthropometric measurements derived from established databases such as ANSUR and CEESAR. These databases provide detailed measurements for various body members, each defined by specific anatomical landmarks that serve as a precise framework for anatomical description. At this moment, anthropometric measurements are provided through a PIPER (http://piper-eu.piper-project.org/) metadata file in the scaling tool. Additionally, with the aid of PIPER metadata files, the necessary landmarks, segments, and sections for the scaling process are defined. To generate these variants, the Scaling Tool has been developed, which uses the anthropometric measurements corresponding to a specific ("target") population and Piper metadata files as input. Through this input, the tool generates an HBM representation by scaling the relevant sections of each body segment. The tool applies advanced morphing techniques to adjust the original HBMs, ensuring that structural and functional coherence is maintained across the body's various parts.

The method ensures that, as the skin surface is scaled and morphed, underlying structures such as muscles, bones, and internal organs adjust accordingly, preserving the interconnected nature of human tissue.

The scaling tool is designed to be universally applicable to all HBMs in the future, thereby allowing for modifications on both individual segment level and whole model-wise, providing flexibility and precision in creating customized body models.

Results

In a proof-of-concept pilot project, the VW group model (modified THUMS) AM50 was successfully downscaled to a smaller individual with a difference in body height of 6 cm. Once the model specific morphing files as well as the target data were defined morphing took a few minutes. The target anthropometry was met, while internal organs, bones, and muscles were adjusted in harmony with the skin surface, maintaining anatomical continuity across body parts. After scaling, only a few manual corrections in mesh quality were needed to finalize the result and meet quality criteria for use in simulations. The presented proof of concept demonstrates the future potential of the Scaling tool enabling scaling of default HBM percentiles to different anthropometries as well as modifying single body sections, e.g. length of legs in a time-efficient way. In the future, this work will be extended to other models including different percentiles and female models.

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