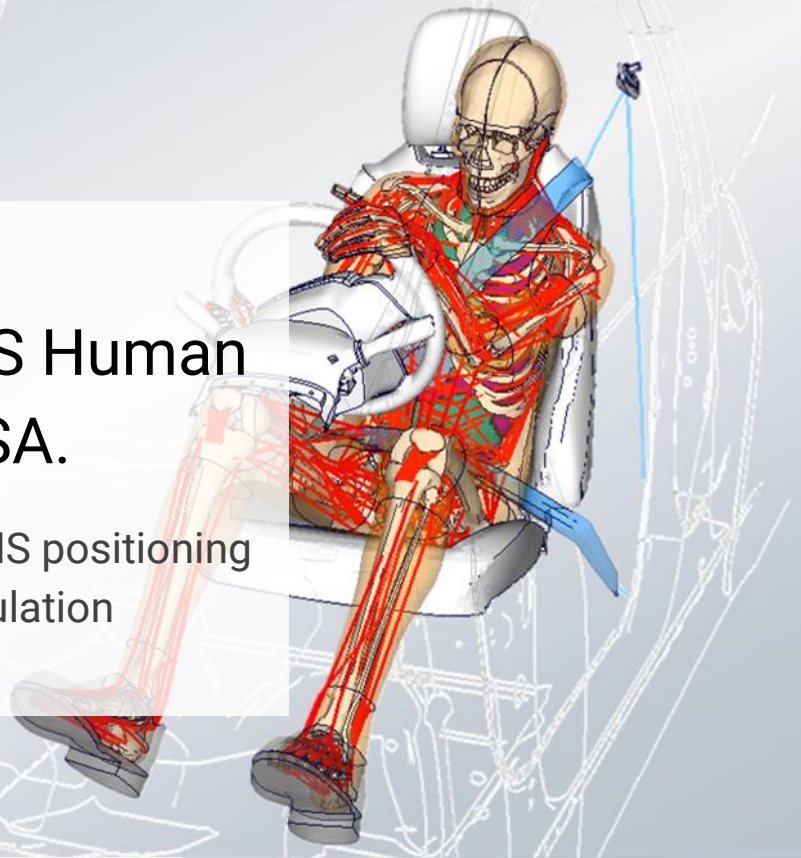**BETA**
SIMULATION SOLUTIONS

Total HUman Model for Safety

Thums®

TOYOTA Motor Corporation

Positioning the THUMS Human Body Model using ANSA.

Evaluating the efficiency of THUMS positioning process using ANSA's HBM Articulation function.

Virtual human body model for analysis of vehicle collision-related injuries

In vehicle collision simulations, human body models positioning should accurately reproduce real sitting postures. This positioning process involves the rotation of joints such as shoulders, elbows, knees as well as spinal movement.

Human joints are composed of bones and ligaments, covered by soft tissues. Pre-simulation is a common positioning method, deforming the surrounding soft tissues with joint rotation.

However, this pre-simulation approach requires long computational time. Also, for large joint rotations, it could deform the joint structure, influencing the bio-fidelity and lowering the element quality of the soft tissue parts.

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"ANSA's HBM function helps accelerate positioning process of THUMS."

TOYOTA Motor Corporation
Noriyuki Fujita
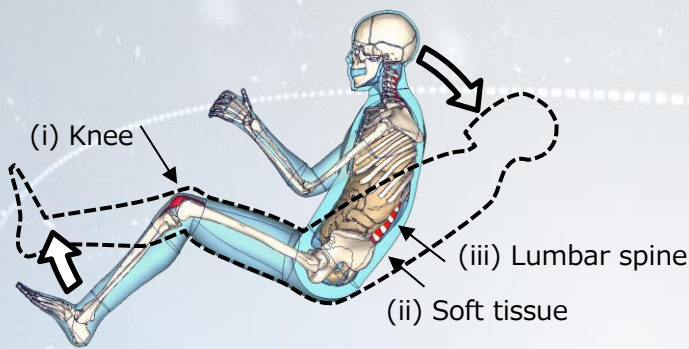
	(i) Knee joint	(ii) Soft tissue	(iii) Lumbar spine
Pre-simulation	Normal shape	Normal shape	Warpage(>50°) :2% Aspect (>3) :1%
ANSA HBM function			Warpage(>50°) 0% Aspect (>3) :1%

Challenge

Evaluation of the efficiency of THUMS positioning process using the ANSA's HBM function, in a demanding positioning case of a reclined seating posture.

Approach

The posture of THUMS was changed from an upright sitting position to a reclined positing at a seatback angle of 45 degrees. Two positioning methods were compared in terms of operation time, one with pre-simulation and the other employing the ANSA's HBM functionality. The deformation of the joint area and the element quality were examined after the positioning process.

During the pre-simulation method, the bone parts were rotated around the joints to achieve the target posture. The user needs to output the nodal coordinate data and manually replace them with the initial data of THUMS.

In ANSA's HBM function, the target angle was specified for each joint using the HBM Articulation tool.

ANSA automatically calculated the soft tissue deformation around the joint to follow the joint angle. The positioned THUMS data was directly output by ANSA.

Results

ANSA's HBM function maintained a natural joint structure without causing abnormal deformation in soft tissue parts while preserving element quality.

- The patella was directly and realistically positioned on the proper location.
- The soft tissue parts maintained realistic deformation, even under high stretching and loosening.
- The element quality of ligament elements also remained decent, even after being loosened due to joint rotation.

It took approximately 15 hours for the positioning process using pre-simulation, including the mesh modification (approximately 2 hours). ANSA's HBM function reduced the operation time by around 90%.

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