

GEOMETRIC VARIATION OF PELVIC BONE IN HUMAN-BODY-MODELS WITH FOCUS ON SUBMARINING RISK

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ABSTRACT –

The phenomena of “Submarining” occurs when the lap-belt slips over the pelvic bone, resulting in severe abdominal and pelvic injuries. Next to the restraint systems, also the geometrical shape of the pelvic bone can influence the occurrence of submarining [1]. This study focuses on the geometrical variation of the anterior iliac wings, a small frontal part of the pelvic bone, based on real volunteer CT-scan data. For this, the image database of the Institute of Legal Medicine of LMU University Munich was used and the most diverse geometries were taken. By using the morphing tools of ANSA Preprocessor, the original pelvic bone shape of a Human-Body-Model (HBM) was modified to these new target geometries.

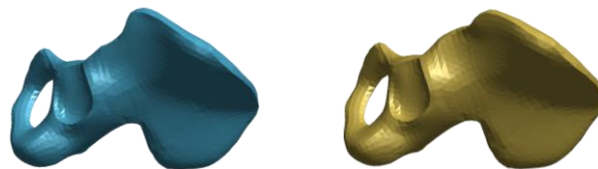


Fig. 1: Comparison of two varied geometries of anterior iliac wings, based on LMU volunteer scan database in HBM THUMS v4.1.

The now varying HBMs were integrated into the generic seat environment of Uriot et al. [2] and positioned in a reclined seating posture, as illustrated in Fig. 2. In the scope of a following parameter study, all considered geometries were compared by doing a 50 times variation of several input parameter by using a Sobol Sampling method [3]. The aim of this parameter study was to answer the question if some geometries show submarining while others do not under the same conditions.



Fig. 2: Setup from Uriot et al. [2] with THUMS v4.1

It can be emphasized, that already minor local variations of anterior iliac wings have an impact on submarining risk. Especially more vertically oriented wings indicate a lower submarining risk, whereas more horizontally oriented geometries are more willing to submarine.

REFERENCES

- (1) Izumiyama et al., Ircobi 2020
 - (2) Uriot et al., Stapp J, 2015
 - (3) Blatman et al., Mechanics&Industry 2007
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