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TYPES OF TOMOGRAPHS FOR VISUALIZATION AND FURTHER FINITE ELEMENT ANALYSIS OF BONES

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Finite element analysis (FEA) helps to analyze stress distribution in the objects. For medical proposals, it is necessary to modulate bone and implant's parameters with FEA to make sure that operation and further rehabilitation will take place without problems.

Only through gradual changes, it is possible to simulate with FEA: Images made by tomographs (DICOM) → Segmentation (Mimics) → meshing (3-matic) → FEA Simulation (ABAQUS) [1]. As it can be seen, the first step is to scan human bone with tomographs and to receive a DICOM file. Main parameters of DICOM file (images) is high resolution and good contrast, as far as this parameters influence on precise of geometry and accuracy of material properties. Now, it is necessary to assess the different types of tomographs in terms of accuracy, efficiency and cost-effectiveness.

X-ray computed tomography (CT). These tomographs gives the images with clear borders between bone and muscles, high spatial resolution but low resolution of image. Mainly using for scanning bones.

Magnetic resonance tomography (MRT). These tomographs give images with good resolution, high contrast resolution but comparing to CT low clearness of tissues border [2]. Mainly using for scanning soft tissues.

Figure 1. Left side picture - MRT vs Right side picture – CT.

Positron emission tomography (PET) is a part of nuclear medicine, functional imaging technique. Images in visible range show chemical processes that take place in human body. Usually combined with CT or MRT data

Based on simulations and studies it was established that it is too complicated to segment data from MRT and resolution of CT is not that low that will influence results of material properties. That is why CT appreciates to be the best tomographs for visualization and further FEA of bones. PET is too expensive in using, but if patient has metal implants, it is the only way to make images.

Literature

1. Weisse B., Determination of the translational and rotational stiffnesses of an L4–L5 functional spinal unit using a specimen-specific finite element model (2012).

2. Rathnayaka K., 3D Reconstruction of Long Bones Utilising Magnetic Resonance Imaging (2011).