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RESEARCH REGARDING CAD MODELING OF THE HUMAN LOWER LIMB BONES

Elena-Iulia HUZU[1], Ioana COFARU[2], Nicolae COFARU[3]
[1]Faculty of Engineering, Sibiu, elena.huzu@ulbsibiu.ro
[2]Faculty of Engineering, Sibiu, ioana.cofaru@ulbsibiu.ro
[3]Faculty of Engineering, Sibiu, nicolae.cofaru@ulbsibiu.ro

***Abstract*—** In this study, we will present the importance of the CAD modeling in bioengineering. The objectives of this study are to create 3D models of the lower leg bones, create a reference system and the component assembly. Using the principles of reverse engineering, we will start from the real bone, taken from human cadavers. After scanning it we will obtain three-dimensional images of the bone in various positions. The model that resulted from scanning was "processed" in the program design CatiaV5R20, SurfaceDesign module. After modeling, we will define proper axes and planes corresponding to the assembly (according to the information obtained from the research literature). Regarding the reference system that we used, we proceeded to the election of a primary reference system to which all 3D bones will be reported. Also, for a better management of the assembly and for highlighting the various pathological situations, we will insert Euler Triedre in the assembly area, between the tibia and foot dome, in the center of the knee joint. Giving to the Euler angles different values, we will obtain different bones positions in the assembly. Creating the CAD system, this will be used in studying various diseases of the bones system and joints of the foot, treatment strategies and surgery.

***Keywords*—** bioengineering, femur, reverse engineering, tibia.

I. INTRODUCTION

THE aim of this study is to create a CAD system, used to study diseases of bones, joints of the foot and strategies for treatment and surgery.

Computer aided modeling finds that when it comes to biomechanical research, the study on 3D models is most appropriate, given that the objects studied are body parts, hard real experiments studied as objects that can not be disassembled, studied and then reassembled.

The objectives of this study are creating 3D models of lower limb bones, creating their assembly reference systems considering the mechanical and anatomical axes existing and creating prerequisites for the study of different possible pathological situations.

II. HUMAN LEG BONES MODELING USING REVERSE ENGINEERING

A. 3D Reconstruction, using Reverse Engineering

In many industrial applications, we need to create CAD models of existing objects that do not have such models.

Reverse engineering, in essence, is a discipline that covers a multitude of activities. While conventional engineering transforms bet on concepts and models in real parts and assemblies, in reverse engineering we have an inverse transformation. This means that the parts and the real assemblies are turned into concepts and engineering models.

Reverse engineering involves strict logical stages of functionality, but in reality it may overlap or it may be conducted with more iteration. The reverse engineering on geometric modeling will go trough the following steps [7]:

1) data acquisition
2) data processing
3) delimitation and building surfaces
4) CAD model construction

The data acquisition is the most important step of reverse engineering in geometric modeling. This step produces data files containing organized coordinates measured and analyzed, contained bet on surface physical object.

Data preprocessing stage is done by triangulation networks extrapolation from scanned object shape coordinates, using a process called geometric reconstruction.

The second step, of delimitation and building surfaces, also is of a special importance. In essence, in this step, the shape made of triangulation networks of the scanned area, is delimited using various fonts, delimited on different areas, using geometric criteria, each building area being an appropriate area that seeks to replicate the geometry area. Also in this stage, we make the "join" for all surfaces.

The last step is CAD model construction. Construction stage solid geometric CAD model of the scanned object, requires synergy level surface representation that is made in the previous stage with CAD platforms. Also bet on this stage is done the "solidification" of the geometrical model, "virtual" object by considering the volume bounded by the surfaces of the object and the possibility of associating the volume specific mass of material properties considered.

The most important equipment in this step that permits to realize the data acquisition is the 3D scanner.