IMAGISTIC INVESTIGATION AND HUMERUS RECONSTRUCTION

Eng. Drd. Mircea Ciprian MATEI
„Politehnica" Universitaty from Timişoara.

Graduate of Mechanics Faculty, Railway Rolling Stock Specialization, 2008 series of graduates. Doctorand with frequency at the Chair of Transportation Engineering.





Certif. Eng. Emese Mirabela MATEI
„Politehnica" Universitaty from Timişoara

Graduate of Mechanics Faculty, Medical Engineering Specialization, 2008 series of graduates.

Honorif. Eng. Prof. Dr. Lucian MADARAS
„Politehnica" Universitaty from Timişoara

Graduate of Agricol Mechanics Faculty, 1964 series of graduates. Doctor in Engineering Sciences since 1977, Honorific Professor of Tehnical University from Cluj-Napoca, Doctorate Coordinator since 1999. At the moment, advisor at „Politehnica" University from Timişoara.



REZUMAT. În lucrarea de faţă se studiază o metodă de investigaţie imagistică a humerusului, respectiv reconstrucţia acestuia în vederea proiectării unui implant personalizat pentru ca braţul să-şi recapete mobilitatea şi funcţiile. Se va prezenta modul în care s-a folosit softul specializat MIMICS pentru reconstrucţia humerusului.

Cuvinte cheie: investigaţie imagistică, implant personalizat, reconstrucţie.

ABSTRACT. In the present paper there is studied a method of imagistic investigation of the humerus, its reconstruction in fact, in order to consider the designation of a custom implant which may allow the arm to get its mobility and functions regained. There will be presented the way that MIMICS software was used for the humerus reconstruction.

Keywords: imagistic investigation, custom implant, reconstruction.

1. IMAGISTIC INVESTIGATION OF THE BONES

Computer tomography represents a method of imagistic investigation, which has its own basis on the properties of X Rays that get through the human body, being absorbed in different degrees by the tissues they've got over, according to their density. On the outgoing they are intercepted by a complex of detectors, which transfers them for the computer for the algorithmic calculation and processing, having as a final result the tomographic images displayed on the screen

The principle that consists in a tomograph computer function, no mater its model or its brand, is based on two penomena:

− the measurement of attenuation of an X Rays fascicle which get through a body and the calculation of the coefficient of attenuation (of density, in fact).

− reconstruction of the image of an object considering its different designations.

The componence of a tomograph computer is presented in figure 1.

2. 3D RECONSTRUCTION OF THE BONES

MIMICS reconstruction of the bones programme makes an interface communication to the scanned data (CT, MRI, Technical scanner, …) and to the fast prototypings in STL or CAD format and the analyse with a finite element. Mimics programme is a package of processing images with 3D collimating functions which

makes an interface communication to all the common scanned formats.

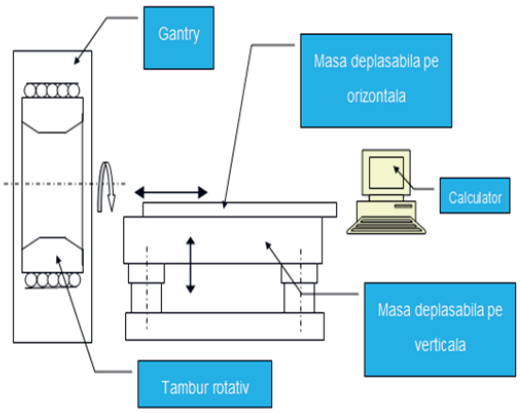


Fig. 1

The additional modules insure the interface between the fast prototyping using STL-s or directly formed with support. Another alternative proposed by the reconstruction of bones programme MIMICS is the very rich CAD interface of the existant prothesis design and also of the new product lines based upon images data or upon available discreetised finite elements.

Materialies's Interactive Medical Image Control System (MIMICS) represents the interractive tool used in order to collimate and to segment the tomograph computer images (CT), but MRI meanwhile and also the redention of 3D objects. In the medical domain, MIMICS may be used for the diagnosis and also for surgery planning. The fast prototyping system represents a very flexible interface and it becomes materialized by distinctive construction of object segments.

The Soft allows user to supervise and to corect the segments scanned by the tomograph computer and MRI. First of all, the antefacts from the images, which proceed from metalic implants, may be very easily erased. The visualised or produced objects may be exactly defined even by the doctor; it doesn't matter having or not having technical abilities or knowledge in order to design these 3D objects (humerus, femora, mandible, cranium etc).

There were especially made different software able to define, compute and pick-up the necessary data for the 3D construction of medical objects.

MIMICS is a general segmentation and image designation programme on different grey nuances, which may be forward evaluated. MIMICS may also process an unlimited amount of images in 2D. The only restriction that comes in here is the physical memory of the computer. The interface is designed to process images with a high degree of complexity pointing their segmentation.

3. PREZENTATION OF MIMICS WAY OF ACTION

In order to exemplify the MIMICS way of action there is presented the way of 3D humerus reconstruction.Thus, the patient which requires the scapulo-humeral implant surgery was previously investigated by tomograph and thanks to the obtained data upon investigations there was to be obtained the 3D model of the humerus.

On the first step there are imported the Dicomm images (figure 2) obtained thanks to the tomograph computer; the imported modules allow the conversion of images variety scanned in MIMICS format. The images may be read from the Hard Disk, Floppy Disc, CD, Optical Discor even from a Casette. If the data are read from the Optical Disk or from the Cassette, than there is necessary to have an Optical Unit which must be fit to read an Optical Disc or a Cassette. The importation of images from the Hard Disc or CD is very easy to be used by the command Import Image Wizard. There is no need of a licence agreement for importation of Dicomm, Tiff and Bitmap images from the Hard Disk or from the CD.

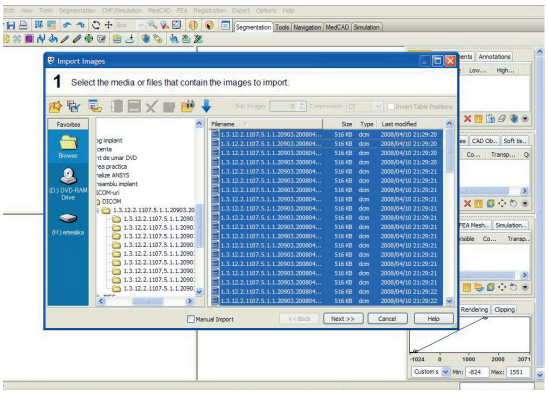


Fig. 2 Dicomm Importation - in MIMICS format.

After the conversion of images there is applied their orientation. (figure 3).

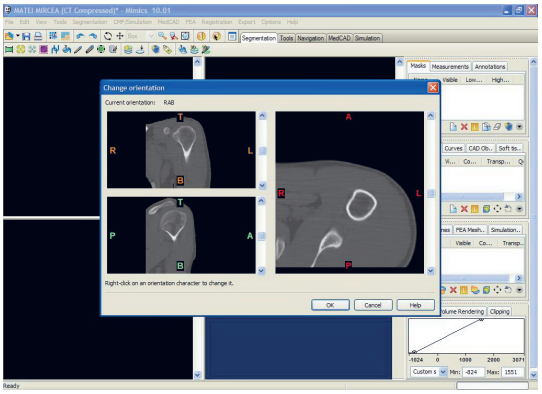


Fig. 3. Orientation of the images.

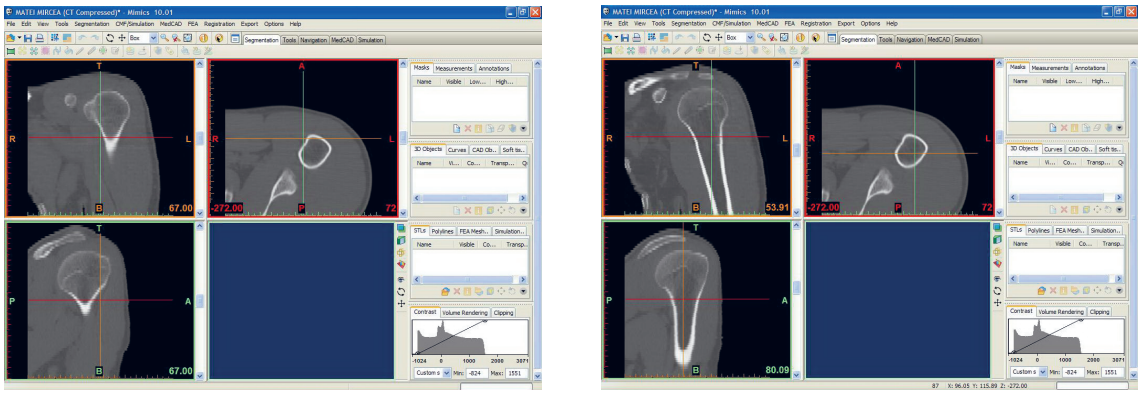


Fig. 4. Procesarea imaginii.

After the orientation of the image was previously done, the project may be run and the image may be procesed using the following commands: Threshold, Region Growing, Calculate 3D etc. (figure 4).

Thanks to Threshold command, the segmented object (collimated with a coloured mask) contains only those pixels of the image with a higher or equal value.Many times there is necessary a lower or a higher Treshold value. The segmented mask contains all the pixels situated between those values (figure 5).

Region Growing Command makes possible the sharing of the designed segment upon the Thresholding Command in more objects or it may erase them either. (figures 7 and 8).

Forward the use of both commands, the Threshold one and the Region Growing one, there is activated the 3D Calculate Command each time, which generates the 3D representation of the bone; in this case there is required the 3D representation of the humerus. (figure 9).

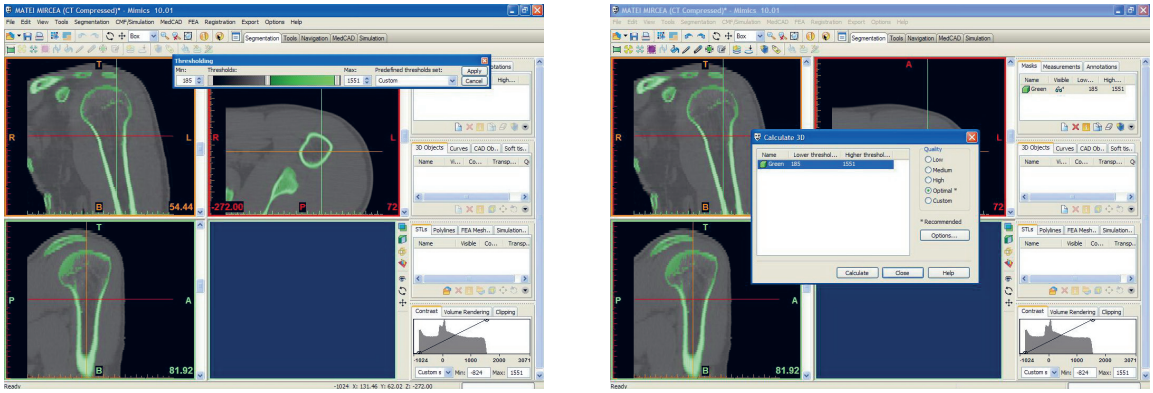


Fig. 5. The use of Threshold command.

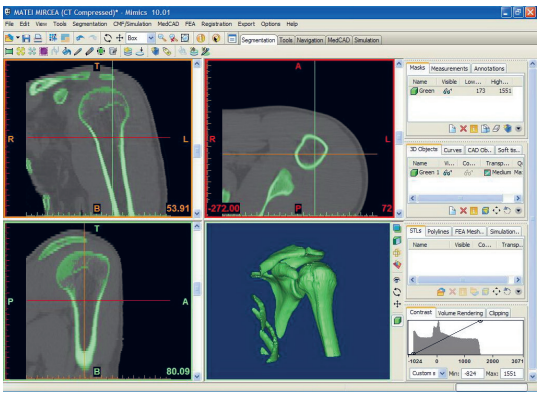


Fig. 6. The Bone obtained after Threshold.

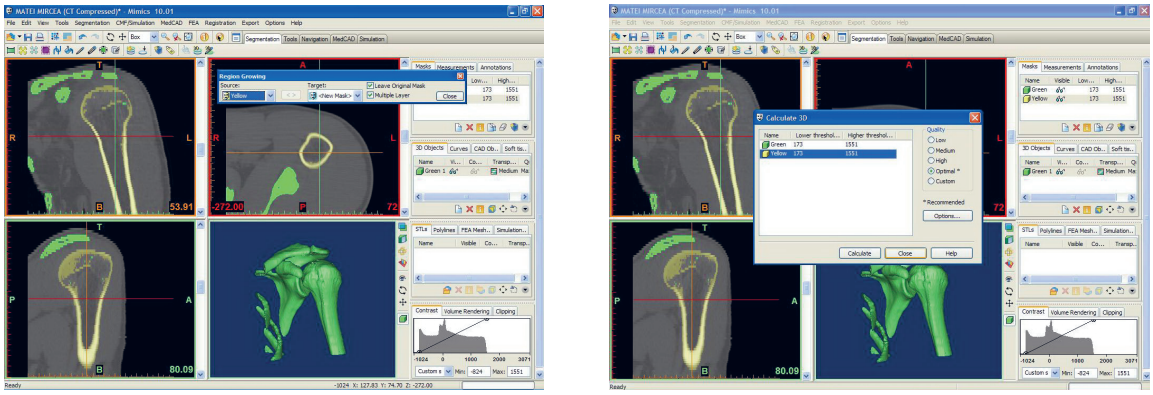


Fig. 7. The use of Region Growing Command.

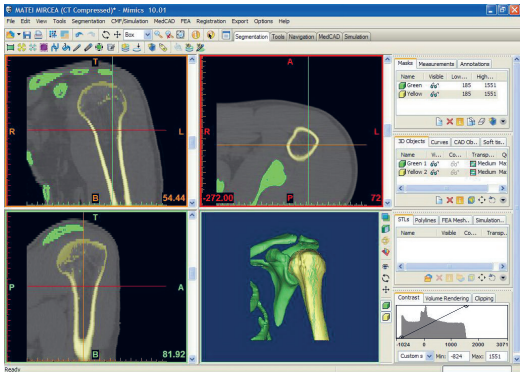


Fig. 8. The Bone after Region Growing.

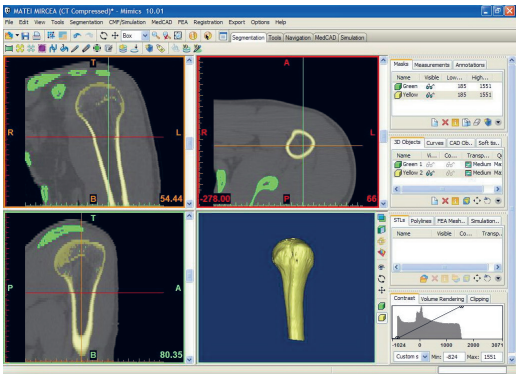


Fig. 9. 3D Humerus Representation.

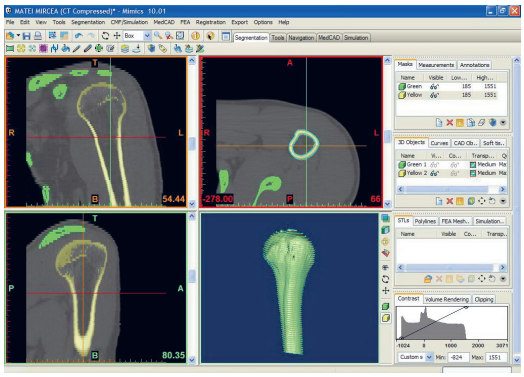


Fig. 10. Polylines Comamand.

There is used Polylines Command which generates internal and external accounts for the 3D recontruction of the bone.

Next to Humerus Discretization achievement, it is imported in Solid Edge where it follows to be processed in order to implant the prothesis of shoulder articulation (figure 12).



Fig. 12. The Humerus imported in Solid Edge.

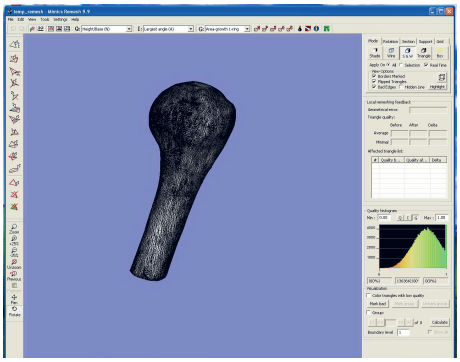


Fig. 11. Humerus Discretization.

4. CONCLUSIONS

1. Materialies's Interactive Medical Image Control System (MIMICS) represents the interractive tool used in order to collimate and segmentate the images from the tomograph computer (CT), but MRI and running of 3D objects, too.

2. Using the modelling technique as a research method in investigation upon the human body has been proved to be very profitable. There may be state that countable progress in medicine were really obtained only when the human body was not any more considered as an indivisible unit, but as a superposal of may systems, mechanisms, organs, functions etc., which there are very well physically and functionally delimitated, being complexly interconnected upon very well determined rules.

3. MIMICS programme used for the reconstruction of Bones System constitutes a considerable contribution in having results of a very high qualitative level.

4. The accuracy of obtained results thanks to use of MIMICS is an incontestable one; thus, it is meanwhile still dependant on the provenience generation of the tomograph computer.

5. Reconstruction of certain parts of the Bones System or even of entire Bones System using MIMICS becomes a start position with many perspectives for the forward simulations or analyses made upon other specialised Software.

BIBLIOGRAPHY

[1] DRĂGULESCU, D., *Modelling in Bio-mechanic*. Didactic Publishing House.
[2] FAUR, N., *Class, The Method of Finite Element*.
[3] STICLARU, C., *Class, 3D Modelling*.