Data acquisition for medical devices

R Veres[1] B C Feier[2] S Ilea[1] G Bohm-Revesz[1]

[1]Faculty of Managerial and Technological Engineering, Doctoral School of Industrial Engineering, University of Oradea, Romania
[2]Faculty of Medicine and Pharmacy, University of Oradea, Romania

ralph.veres@catedral.ro

Abstract. Following the path of the powerful evolution in many fields, engineering and medicine are converging to a healthy collaboration. Engineering, as a profession, is a practising one, and it is based on modifying and harnessing the three fundamental resources of the known world: information, energy and materials. Delivering solutions using the latest technologies and also trying to innovate for a better world, the continuous advancement of methods and many other improvements are focusing on helping and developing new ways to have better results. Medicine, with its many fields, is going hand in hand with this exponential growth. One method used in engineering to study and characterize different processes or phenomena is the acquisition and digital processing of data. With the development of computational techniques, it became possible to capture biological data, radiography and tomography being two examples that allow the reconstruction of images that are useful for diagnosis and establishment of treatment. In the following paper, methods known in the industry are presented and related to different procedures used in this collaboration between engineering and medicine.

1. Introduction

The first element used to work with is information. The central and key element for research is data and the need for acquisition it. New methods are coming to the market with improvements, considering the predecessors, being also more efficient, cost-effective and precise, this component is mandatory for present applications.

As presented in [1] and [2], there are many amounts of information in the surrounding world, the intent being to acquire and process this kind of data for useful applications. Acquisition data is done by processing the sampling signal that shows us surrounding conditions and then turning the resulted data into digital or numeric values that can be manipulated by computer-aided programs. In the evolutive field of medicine, the basis for ethical practices is represented by information samples that can lead to precise and useful analysis.

The need for capturing three-dimensional models has become a necessity in the last years, mainly due to rapid evolution on 3D technologies and also for the need of evolution the imagistically zone of medicine.

2. Methods

Very common and a beneficial method in our days in represented by Magnetic Resonance Imaging, also known as MRI, and uses strong magnetic fields and radio waves to generate images of organs in the human body.

Modern magnetic resonance imaging techniques can provide high-quality anatomic details, even too small organs and extremities such as feet and hands. The benefits of MRI are represented by real-time visualization of anatomic structures, like significant blood vessels and also for the display of the soft tissues, sub-structures and surrounding organs and components, as the authors suggest in [3] and [4].

MRI can provide a big amount of data and information resulting from that the analysis of these becomes a complex task for clinicians, being time-consuming and can inquire errors. Nowadays, computerized methods can assist clinicians for this data diagnostic—segmentation method most used in the field of MR data processing.

Segmentation comes hand in hand with 3D imaging and design programs used to reproduce full-scale models of the organs that are scanned (figure 1). Programs like 3D Slicer and Mimics that can transform DICOM files resulted from an MRI scan to many other formats, like STL are stepping forward, furtherly being capable to modelling and optimize different organs or structures in the computer-aided programs.

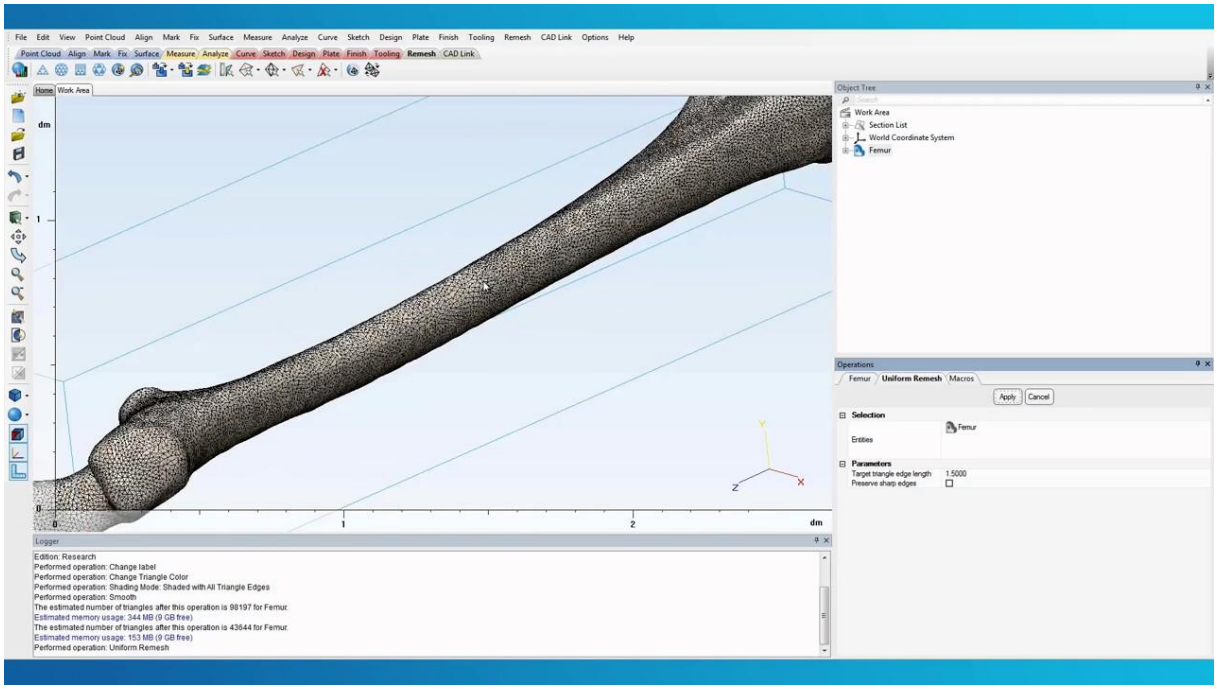

Figure 1. A femur reconstruction in MIMICS, after an MRI scan segmentation.

There are also a few possibilities of capturing 3D models, as presented in [5],[6],[7], the most known being 3D scanning. This technique is spreading in new domains and makes a powerful appearance in the medical sphere. 3D scanning brings advantages, the most common one being the volumetry. To be able to observe parameters of the human body is one of the most important factors in diagnosis and also for evaluations that can result after it.

3D scanning has an advantage compared to other methods: the spatial resolution of models that can also be enlarged by one dimension and can be registered in relation to other parameters.

On the present market, we can find different 3D scanner (figure 2) with different principles, but the main feature of them is they can have modules implemented. The first module is the raw data capturing, where most of the scanners measure the distance of the surface from the sensor. Another module is represented by the sensor movement, that allows building an elaborate 3D model by positioning the scanner's sensor in several viewpoints from which all the details of the object and surface are visible. Another module is represented by computation of the 3D point position. Mainly, 3D scanners use

geometric transformations to build a 3D model, and can be used to model and optimize furtherly the objects.

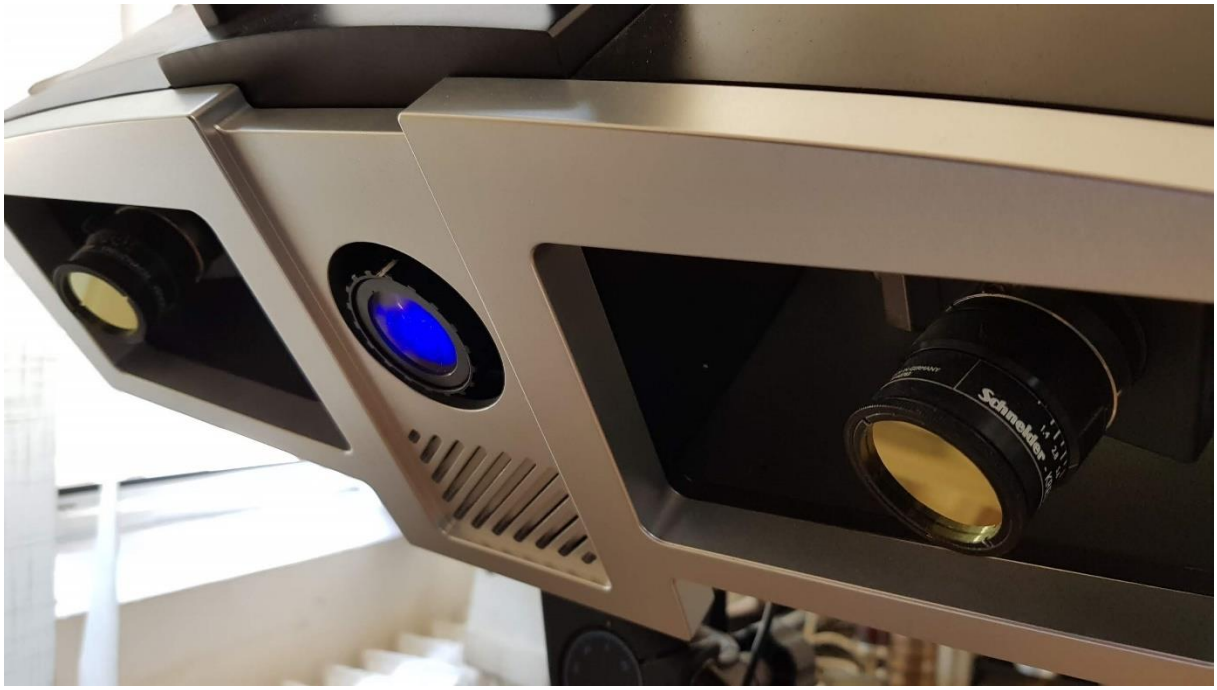

Figure 2. 3D scanner.

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On the present market, we can find different 3D scanner with different principles but the main feature of them is they can have modules implemented. The first module is the raw data capturing, where most of the scanners measure the distance of the surface from the sensor. Another module is represented by the sensor movement, that allows building a complex 3D model by positioning the scanner's sensor in several viewpoints from which all the details of the object and surface are visible. Another module is represented by computation of the 3D point position. Mainly, 3D scanners use geometric transformations to build a 3D model and can be used to model and optimize furtherly the objects.

Advantages of 3D scanners are undeniable are consistent in comparison with other methods. Here are some of them, as the authors help us to consider them in [1]:

- Low operational cost – the ease of use and operation is not as difficult as MRI/CT equipment
- Simple manipulation – is a simple system, mainly with a very accessible user interface, and also with very simple handling, it can be facile to use by the personnel
- High speed – related to time efficiency, 3D scanning is fast and time-saving
- Accuracy – Modern 3D scanners are very accurate, this being the essential parameter for good results and the main parameter to distinguish changes of human body
- Harmless operation – there is no harm for both the personnel or the patient, as it is in other methods, like CT scans, Radiography, etc.
- No limitations – it can be used in many cases, being no limitations regarding different parts in the human body (stents, pace-makers, etc.)

3. Conclusions

In terms of advancement, medical imaging is aided with technological improvements that bring us new methods to develop new products, new techniques and brings us viable solutions in the sphere of

research. For us, in the zone of PhD research, this kind of methods can help us raise the quality of our research and also defines us the primary three needs of engineering: cost optimization, high quality and reasonable time.

Compared to other methods, 3D scanning brought us advantages, mainly in cost optimization zone, but also in quality and time essential parts, compared to more known CT/MRI scans and also helps us improve basic knowledge of the nonconventional technologies applications in the field of medicine.

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