Automatized Technique for Three-Dimensional Reconstruction of Cranial Implant Based on Symmetry

Oleg Avrunin, Maksym Tymkovych, Jahed Drauil
Department of Biomedical Engineering
Kharkiv National University of Radio Electronics
Kharkiv, Ukraine
gavrun@list.ru, maxim.tymkovich@gmail.com

***Abstract*— Currently, reconstruction of cranial implants using tomography study is necessary. The work is dedicated to the automation of the process of cranial implant reconstruction. We propose a set of image processing operations at three-dimensional reconstruction of cranial prosthesis using symmetry.**

Keywords—cranial implant; reconstruction; image processing; symmetry; image pyramids

I. INTRODUCTION

Nowadays, plastic surgery is widely used in human life. Among these cases, cranial plastic surgery occupies an important place [1]–[2]. Especially if one takes into account the ever-increasing number of injuries caused by the fighting in the east of Ukraine.

In recent years, 3D printing has been increasingly used for cranial prosthesis. Available 3D printing technologies are used for many purposes, such as making prosthetic appliances of hands, feet, skull, etc [3]–[7].

One of the most important advantages of 3D printing is the speed of production. At the same time the process of developing models for printing, especially prosthesis, takes a very long time [8]–[12].

Many papers are devoted to the development of tools for interactive reconstruction of the cranial implant. Among them is the work of [13] which describes the process of reconstruction of the prosthesis using Bezier curves.

Therefore it is necessary to develop a system of reconstruction of the cranial implant using data computer-aided tomography [14]–[15].

II. GENERAL STRUCTURE

The general structure that describes the process of reconstruction of the implant is shown in Fig.1.

Fig. 1. General structure of the process of reconstruction of a cranial implant

Input data are previously amenable to a primary processing stage. The next step is searching of symmetry and segmentation. From the data obtained, the last block reconstructs a 3D model which is the result.

The block of bone segmentation separates a bone from the other pixels of the image. The search block determines the symmetry line on the basis of which we reconstruct the mplant.

III. INPUT DATA AND PREPROCESSING

The initial data is a set of computer-aided tomography (CT) slices of the head. These sections make up the entire amount of the study of the head. Fig.2 shows the input data with a head injury.

All data is stored in DICOM study [16]. In this study, in addition to the image, the file also contains additional information such as pixel size, distance between slices etc. The DICOM is divided in many tags. Each tag stores some specific information. The DICOM tag (0018; 5100) must contain a "HFS" line that means "Head First Supine". It is also possible to convert DICOM data into this view.

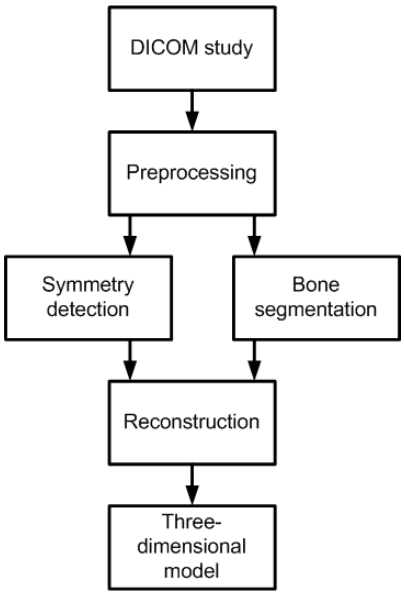

Fig. 1 General structure of the process of reconstruction of a cranial implant