Abstract

Introduction: Modern medicine uses many diagnostic methods to accurately diagnose a patient. The information obtained by the various methods is complementary, and when all are combined, a very accurate picture of the patient's condition can be obtained. One of the most significant problems in diagnostic imaging is the image registration, since each examination is performed at a different time, in a different patient position and with a different method. This situation results in images that may be arranged differently, making them difficult to compare. This problem can be solved by using appropriate image processing methods. **Objective:** The aim of the work is to develop a methodology and optimize the image registration of different modalities using different image processing methods. **Materials and Methods:** In this study, simple synthetic images and medical images acquired with MRI and PET/CT devices were used. In order to register medical images, image processing methods such as Navier-Lame method, MIRT, Tool of Kroon were used. In addition, the effect of pre-processing on the quality of image registration was tested, and the FEM method was used to perform image registration under conditions of large organ deformations. The work also included building a special holder for the patient's body to perform CT examinations in the prone position, and building a series of breast phantoms to study elastic deformations.**Results:** In this work, a number of results were obtained showing the performance of the relevant algorithms. Comparative methods like SSD, MI and DICE index were used to evaluate the accuracy of image registration. The tested methods of flexible image overlay allow for image registration of mono or multimodal images, but not in every case. For MRI images of the breast, they proved to be insufficient hence it was decided to use a biomechanical model and finite element method for its deformation. This method proved to be effective in matching even

images under conditions of large deformations registered in different positions of the patient. **Summary:** The obtained studies allow us to conclude that the use of image processing methods, can be useful in medical practice, especially for large deformations.

Keywords: images, diagnostics, images registration, images fusion, FEM