ROBUST METHOD FOR EXTRACTING 3D MEDICAL OBJECTS FROM MRI DATA

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1. Introduction

Magnetic Resonance Imaging (MRI) is a medical imaging technique widely used for visualization of internal body. Due to its characteristics it is mostly used for visualization of soft tissues. Usage of MRI grows every year, mostly because of its non-harmfulness, as opposed to Computed tomography (CT). With development of computer science some techniques for segmentation of CT and MRI data emerged[1]. The work presents a robust method for extracting partial 3d spine model from MRI. Presented algorithm is being developed by specialists from Poznan University of Technology in cooperation with University of Medical Sciences and Rehasport Clinic. The purpose of this cooperation is to meet the actual needs of physicians in the domain of medical visualization, increasing the level of treatment and as a result patients' quality of life.

2. Materials and Methods

Special algorithm for spine segmentation from MRI images was prepared. Presented solution is based on Constraint Local Model (CLM) [2] algorithm and combines Machine Learning (ML) techniques with Principal Component Analysis (PCA)(Fig.1)[3]. The data for the study was provided by Rehasport Clinic. For proper geometry extraction a total number of 40 examinations containing sagittal and coronal images was used. Low resolution of presented data, high noise and non-homogeneous information about the tissues enforced to increase the quality of input data by initial filtration. After that automatic vertebrae recognition was made. ML techniques were used to build two different models using Support-Vector Machine (SVM)[4]. First model was trained to recognize each vertebra from the DICOM images, while the second model was meant to recognize characteristic features. Simultaneously a PCA analysis was made on pre-prepared data to determine mean vertebra shape and its variations. Combined information about shape and appearance gave a high quality model used for search and extraction of desired geometry.

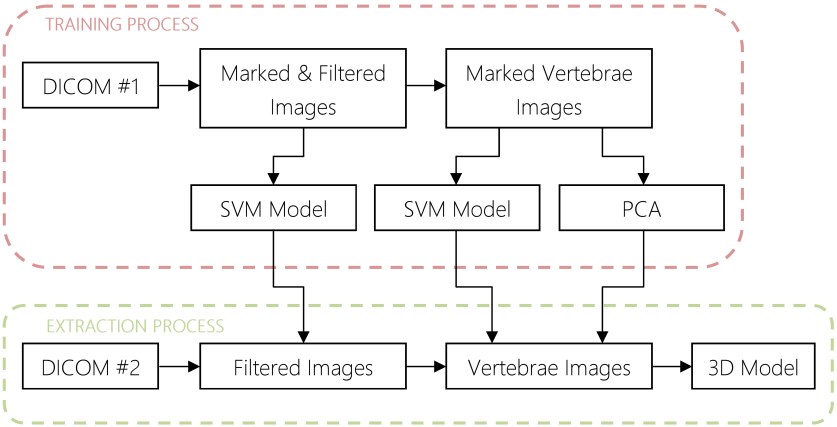

Figure 1. Flow chart of presented method for extracting 3D objects from MRI data. Machine learning techniques and Principal Component Analysis are used for precise tissue segmentation.

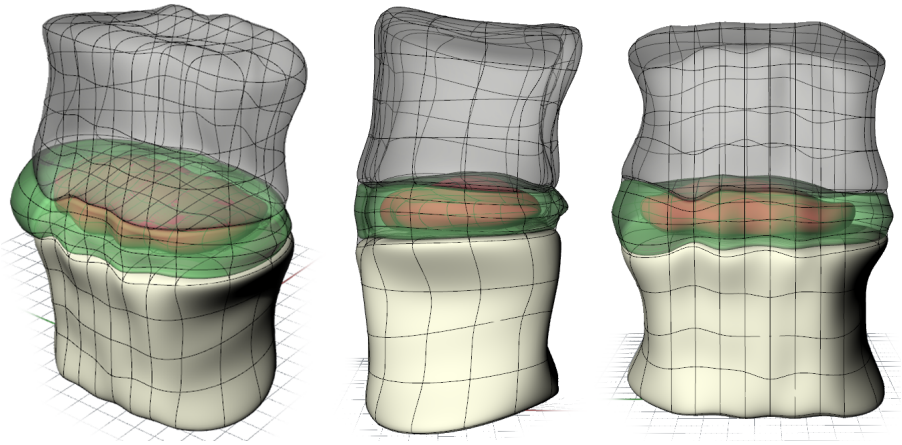

Figure 2. Result of presented algorithm - 3d model containing intervetbral disc and nearby vertebral bodies. The model is parametric - based on interpolating curves.

3. Results

Proper segmentation of vertebrae from DICOM images was obtained. From extracted information a 3d model containing intervetbral disc and nearby vertebral bodies was made (Fig.2). Created model, comparing to standard 3d medical visualization techniques, was parametric - based on interpolating curves.

4. Conclusions

This work presented a solution to the MRI 3d visualization problem. Presented method extracts selected tissues from the images and creates 3d model fully automatically. Additionally this solution can be used on incomplete/damaged data filling the model with information about most probable shape obtained from machine learning process. What is more presented algorithm changes the standard approach to the 3d medical visualization from discrete information (3d voxel representation) to continuous information based on interpolating curves (independent from resolution and quality of the images). Such solution solves the problem of limited information provided by MRI examination. On the other hand the work is not flawless, currently the algorithm extracts only intervertebral discs and vertebral bodies. In the future additional work will be done to extract the whole spine.

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References

[1] D. Gawel, P. Glowka, M. Nowak and T. Kotwicki (2016).Visualization of the medical imaging data in 3D space using portable format, *AIMS Bioengineering*, **3(2)**, 176-187.

[2] D. Cristinacce and T. Cootes (2008). Automatic feature localisation with constrained local models, *Pattern Recognition*, **41**, 3054-3067.

[3] H. Abdi and L. J. Williams (2010). Principal component analysis, *Wiley Interdisciplinary Reviews: Computational Statistics*, **2:4**, 433-459.

[4] I. Steinwart, A. Christmannr (2008). *Support Vector Machines*, Springer-Verlag, New York.