Research project proposal – Project title

"Mathematical modeling in 3D heart registration, quantification and visualization based on semi automatic CT image segmentation"

Background (max 500 characters)

3D heart registration has become an important issue in cardio vascular diagnosis and treatment. This is mainly due to advanced medical imaging technologies that provide significant amount of data with high precision. However this large amount of high resolution data needs to be adequately processed (mainly used for segmentation), therefore asking for smart computer vision and machine learning algorithms [1], [2]. This is considered highly necessary since manual segmentation by medical technicians is very time consuming and may not be reproducible. Although large number of image segmentation algorithms has been proposed for various applications [3], each particular image segmentation approach in medical imaging is highly dependent on imaging technology and requires (i) detailed analysis of the acquired images and (ii) consideration of the specific task to be automatized [2]. Each specific task requires adequate mathematical modeling with machine learning that would allow computer aided decision making and procedural operations with least assistance from medical doctors.

To successfully create such models classical knowledge is needed as well as familiarity with the latest results of the mathematical disciplines such as pattern recognition, soft computing (fuzzy mathematics, neural networks, genetic algorithms), graph theory, image processing, computional and discrete geometry,...

Project description (max 750 characters)

This project focuses on processing of medical images of the heart consisting mainly of 3D segmentation, registration, physical measurements and 3D visualization. From the theoretical point of view the main aim is to investigate different mathematical models for particular 3D heart segments and develop semi-automatic approach with artificial intelligence based on suitable machine learning methodology. From the implementation point of view the idea is to implement all these features in a new Graphical User Interface (GUI) application based on C++ libraries in VTK and QT. However, for initial algorithm development and research investigation Matlab will be used.

The project is targeting the future project proposal: **H2020 – Personalising health and care, H2020-PHC-2015-single-stage_RTD.**

References (max 5)

1) Z. Ma, J. M. R. S. Tavares, and R. M. Natal, "A review on the current segmentation algorithms for medical images," in First International Conference on Computer Imaging Theory and Applications, (Lisboa, Portugal), Feb 2009.
2) S. Sharma and L. Aggarwal, "Automated medical image segmentation techniques," Journal of Medical Physics, vol. 35, no. 1, pp. 3–14, 2010.
3) R. Szeliski, Computer Vision: Algorithms and Applications. Springer, 2010.

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