

Activity report, stage 2

“Kinematic modeling of the innovative robotic structure. Development of the mechanical structure and the command system. Development of the virtual reality software.”

The second stage of the ROBOCORE project continued the research started in the first stage. The four proposed robotic solutions are subject of two patents, registered to OSIMA during this stage of the project.

The kinematic models were developed for the robotic solutions, and based on the transperineal prostatic biopsy study, taking into account the operating room equipment, the robotic systems dimensions were established, which in turn resulted in the computation of the operational working space for the proposed robotic solutions. The direct and invers geometric models were computed for each individual structure, and the resulted solutions were analytical which offers an advantage in implementing them into the robot command and control unit. Also the Jacobi matrices were computed allowing the studies for possible singularities, studies that are essential to ensure the robot safety and functionality. A graphical system for robot simulation (developed in MATLAB) was developed for a fast and reliable validation of the robot structures. This graphical system studies the kinematic behavior of the robotic structures and thus, it determines the optimal position of the robot, relative to the patient.

Also, during this stage a method was developed, for 3D modeling of the region on interest from MRI images, method that was adapted for the reconstruction of the patient prostate. Furthermore, a prototype software was developed and implemented, that allows the definition of some marker points into the 3D model of the patient prostate (reconstructed from the MRI), and the integration of the obtained results into the TRUS (Transrectal Ultrasounds) images. Also in this project stage a 3D environment was modeled which includes the robotic structure BIO-PROS-1, a virtual human model, and other relevant medical equipment, that are necessary for the biopsy robotic system validation. An augmented reality environment was modeled that includes a real robotic structure (for testing purposes) and a virtual human model.

The achievement of the project stage objectives, was part of the collaboration work among all the partners involved in the project: Technical University of Cluj-Napoca (CESTER), Medical and Pharmaceutical University of Cluj-Napoca (Urology Clinic of Cluj), Transilvania University of Brasov (Robotics and Virtual Reality), Electronic April SA Cluj.

Analyzing the achievement of proposed objectives in the 2nd stage of the project implementation plan and deliverables obtained it can be said that all activities, goals and deliverables were completed 100%. Thus, there were not recorded any delays, irregularities or corrections to the originally defined activity plan.