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WT2.9: University of Bradford

Report

Activities performed during the visit at the Wroclaw University of Technology

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Visiting person name: Mhd Saeed Sharif

Period: 25.04-1.05.2015

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This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 316097 [ENGINE].

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1 Personal Information

Dr Mhd Saeed Sharif works in a group of Visual computing technologies leaded by Professor Rami Qahwaji at University of Bradford

2 Seminars

Seminar entitled: "Medical Image Analysis for Confocal Corneal Data sets" was given on April 27, 2015. in room 12-0/201 building D2 for Computational Intelligence Department of Wroclaw University of Technology.

3 Scientific activities

On 28 of April Dr Mhd Saeed Sharif in the assistance of dr Martin Tabakow, has visited the 'AKSON'[1] - Neuro-Rehabilitation Center for the Treatment of Spinal Cord Injuries in Wroclaw, Poland. The aim of the visit was to discuss possible cooperation in a research project, concerning the development of intelligent artificial prosthetic limbs.

On 29 of April 2015 scientific meeting of a group interested in applications of IT techniques in medical image processing was organized. In the talk some of the technologies and applications developed in the field of visual computing in close collaboration with some industries such as the NHS and the European Space Agency (ESA) were described.

During discussion, the following topic as a possible cooperation was agreed as '*Intelligent 3D-printed arm*'

The aim of this research is development of 'smart' 3D-printed prosthetic limbs, with adaptation mechanism (for example based on learning procedures), which would provide sufficient functionality for patients, based on surface electromyography (sEMG) signal analysis. The adaptation mechanism should relate the sEMG signal values to corresponding degree of device reaction (artificial arm reaction).

The following levels of research complexity can be considered in further cooperation:

Level 1 - simple: Engineering approach – it is enough to monitor only one muscle with respect to the sEMG and a corresponding threshold value (T). The arm will be controlled in binary

[1] This rehabilitation center became famous, as it was involve in the rehabilitation process of the first World known patient, who achieved a significant regeneration of functionality after pioneering neurosurgery transplantation (https://www.youtube.com/watch?v=rhFHQMrrz4E).

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mode with trivial control rule – If the sEMG reaches values > T then 'action1' (if the previous action was 'action 2') or 'action 2 ' (if the previous action was 'action 1') .

Level 2 – a little more complex: Research & Engineering – we may introduce smoother operation of the arm, by applying fuzzy control (of type 2) for example. The degree of 'arm action' should give better performance in practice, more sensitive to real objects – I mean, there is difference between grabbing egg or glass, than objects made from steel.

Level 3 – complex: Research & Engineering – we may extend the research from level 2, by monitoring of groups of muscles. This should increase the functionality of the arm.

All above subprojects, should involve learning procedures as well as corresponding rehabilitation procedures, in order to adapt the software parameters to a specific patient (to personalize the arm).

Level 4 – very complex: Research & Engineering, assuming cooperation with appropriate medical facility - electrodes for prosthetic arm permanently implanted into the stump. Therefore, the objective is to achieve almost perfect arm substitute with surgery support.

There is a lot of research done in the area of intelligent prosthetic limbs, but the challenge is still in the software solutions applied. The perfect solution would be the combination between level 3 and level 4 – this would be a significant achievement.

During the meeting in AKSON, dr Sharif was introduced to the specificity of sEMG acquisition and signal interpretation. Also, the research direction of modern rehabilitation was discussed. The basic problem in the therapy procedures for patients with severe spinal cord injuries, is the recognition of small changes of the physical condition of the patient. The generally applicable ASIA scale, introduced by the American Spinal Injury Association which includes the Lovett system are too general, i.e. they are not designed for tracing of small changes of values, for example in the sEMG or other signals, in purpose to recognize relatively small changes of patients physical condition during the rehabilitation process. The recognition, the tracing and finally the visualization of these changes is of significant importance for modern, supported by digital technologies, rehabilitation.

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