



WT2.13: Department of Signal Processing Tampere University of Technology, Finland

Report

Activities performed during the visit at the Wrocław University of Technology

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Visiting person name: Michał Joachimiak

Period: 04.09.2015 - 04.03.2016

1. Personal Information

Michał Joachimiak received the Master of Science degree in Computer Science from the Faculty of Technical Physics, Computer Science and Applied Mathematics, Lodz University of Technology, Lodz Poland in 2006. Between 2007 and 2009 he was a Computer Vision Researcher at the Department of Measurement and Information Technology, Tampere University of Technology. In 2009 he has joined the Department of Signal Processing, Tampere University of Technology. Between 2009 and 2013 he was a researcher at the Nokia Research Center, Tampere, Finland, where he conducted research on topics related to 3D video acquisition, processing and compression including work on the 3DV-ATM reference encoder. He is in the final stage of his Ph.D. degree studies. He is a recipient of the Nokia Foundation scholarship and the HPY Foundation scholarship. His current research interests focus on 3D video processing, saliency estimation and information retrieval from visual data.

2. Seminars

1. On 10.09.2015 the talk at the Training Workshop on Machine Vision and Graphics entitled “3D video processing with industrial applications” was given. The presentation covered the design of 3D imaging devices and 3D video processing techniques aimed at industrial applications including:
 - a) real-time analysis of the paper surface in the running calendaring machine
 - b) 3D image processing chain for log end analysis at the forest harvester
 - c) 3D video acquisition systems with circular camera setup
 - d) 3D video encoding and streaming on the mobile devices



During the Training Workshop on Machine Vision and Graphics several meetings and talks were conducted either with local researchers from Wrocław University of Technology and University of Wrocław or research representatives from other Universities in Poland. The cooperation between the visitor and Lukasz Piwowar, PhD from University of Wrocław was started and the conference paper is in preparation (see Scientific Activities Section for details).

2. Invited talk at the Institute of Information Technology, Lodz University of Technology entitled “Advances on 3D video processing and compression” presented on 12.01.2016. During the talk the ENGINE Center was introduced and possibilities for cooperation were investigated. The scientific discussions took place with the following researchers:
 - a) Prof. Piotr Szczepaniak,
 - b) Arkadiusz Tomczyk, PhD

3. Invited talk at the Institute of Control and Information Engineering, Poznan University of Technology entitled “3D video compression and processing” presented on 14.01.2016. In addition, Michal Joachimiak held a series of meetings to introduce ENGINE Center at the Institute of Control and Information Engineering and the Chair of Multimedia Telecommunications and Microelectronics, Poznan University of Technology. The scientific discussions took place with the following researchers:
 - c) Prof. Marek Domański,
 - d) Piotr Skrzypczynski, Ph.D, D.Sc.
 - e) Olgierd Stankiewicz, Ph.D
 - f) Krzysztof Wegner, Ph.D

As a result of these discussions the work on two conference publications in cooperation with Olgierd Stankiewicz and Krzysztof Wegner has started. The details can be found in the Scientific Activities section.

4. The presentation entitled „Visual saliency estimation for 3D video encoding” was given on 17.02.2016 and covered the state-of-art saliency estimation algorithm and its application to foveated 3D video encoding.

3. Scientific activities

The goal of the visit was to transfer the know-how on 3D video research that was conducted during visitor’s work at the Nokia Research Center, Tampere, Finland. The topics covering research methodologies, algorithms for 3D video acquisition, encoding and enhancement, subjective evaluation of 3D video quality and possible areas still open for scientific exploration were discussed at the Human Computer Interaction laboratory. Moreover, the visitor collaborated with the Head of the Department of Computational Intelligence in the area of concept learning for video analysis. As the result of this collaboration the scientific project proposal was submitted to the National Science Centre in Poland. The main collaborators at the Wrocław University of Technology were:

- a) Professor Halina Kwasnicka
- b) Janusz Sobacki, Ph.D,
- c) Piotr Chynal, Ph.D

The following outcomes of the cooperation are either realized or close to realization:

1. The algorithm for visual saliency estimation based on quantum cuts on 3D video was developed. A novel algorithm for foveated 3D video compression is also proposed. 3D video sequence is compound of texture and depth views that comprise of redundant information. Based on the characteristics of the Human Visual System including binocular fusion theory and retinal eccentricity some of the information can be removed by decreasing the cutoff frequency. The results of the scientific research in this area will be published as a transaction paper entitled:

M. Joachimiak, C. Aytekin, S. Kiranyaz, P. Chynal, J. Sobacki, M. Gabbouj “Fast Visual Saliency Estimation for Foveated 3D Video Encoding” IEEE Transactions on Circuits and Systems for Video Technology, in preparation.

2. The measurement set-up for subjective visual saliency measurements on 3D video was prepared. The test stand is arranged based on the dedicated desktop computer, Tobii TX300 gaze tracker, 3D TV with shutter glasses and chinrest for subjects, was arranged. The set-up is used for ground-truth data acquisition and subjective 3D video quality evaluation. In addition, the measurement set-up is serving for the depth perception measurements.

3. The visitor initiated cooperation between the Human-Computer Interaction laboratory at the Faculty of Computer Science and Management, Wrocław University of Technology and the Institute of Computer Science, University of Wrocław.

As a result of the cooperation the software for 3D video rendering with use of motion parallax effect was developed to work in real-time on GPU processors. After further testing and measurements of the depth perception with motion parallax effect, the results will be published as a conference paper:

M. Joachimiak, L. Piwowar, K. Wegner, et al., „Evaluation of 3D Video Depth Perception via Binocular and Motion Parallax” IEEE Conference on Visual Communications and Image Processing, Chengdu, China, in preparation.

4. The work on algorithm for 3D video denoising, based on 3D DCT transform, has started. The visitor initiated the cooperation between the Faculty of Computer Science and Management, Wrocław University of Technology and the Chair of Multimedia Telecommunications and Microelectronics, Poznan University of Technology. After further developments the outcome will be submitted as the conference paper. The results of this work will be submitted as the conference paper:

O. Stankiewicz, M. Joachimiak, H. Kwaśnicka, “View Warping for Multiview 3D video denoising in 3D DCT domain” International Conference on Image Processing Theory, Tools and Applications, in preparation.



5. The visitor cooperates with the student Piotr Rarus, Prof. Halina Kwasnicka, Head of the Department of Computational Intelligence at Wrocław University of Technology and Lukasz Fulawka, Wrocław Medical University in order to create the system for breast cancer tissue classification based on Ki-67 marker.

3. Project proposals

1. The project proposal entitled “Knowledge conceptualization for video understanding” was prepared in partnership with the Head of the Computational Intelligence Department Professor Halina Kwaśnicka and submitted to the National Centre of Science as a response to the “Polonez 1” call. The project aim is to propose novel deep learning network topologies that work with ontologies and are able to discover concepts in visual data. The decision on the project funding will be published on June 15th, 2016 and can be found at <https://www.ncn.gov.pl/finansowanie-nauki/konkursy/wyniki>.

