ERCIM "Alain Bensoussan" Fellowship Scientific Report

Fellow: Anders Hast
Visited Location :   IIT, CNR, Pisa, Italy
Duration of Visit: 12 months
Scientific coordinator: Andrea Marchetti

I - Scientific activity

During the fellowship period new research was conducted in three areas in which I had not published anything before: Image Processing, Virtual Cultural Heritage and Computer Vision. In my PhD studies I studied Image Processing but during the period I had to make a thorough literature study about illumination correction and its applications. Similarly I had to read about Virtual Heritage and especially make a fundamental literature study about Computer Vision in general. Many algorithms were implemented and tested in order to see how they work and if they could be useful for the Geomemories project that is a web implementation of a historical atlas of the Italian landscape. My part was concerned on how to improve the images before making the mosaic of photos. The result was one new algorithm for illumination correction that also can be used in other fields, like face recognition and microscopy.

In the field of computer vision the main algorithms that were investigated and improved concerns image matching. One new algorithm was produced and a major improvement to another algorithm was developed. As this algorithm (RANSAC) is used in many applications for image stitching and object recognition it is expected it will have an impact in all fields using such an algorithm. It will perhaps have less direct impact on the project as it will probably use commercial software for this purpose. However, in the end we hope that our algorithm can be used also for commercial software.

Moreover a number of methods and algorithms were tested and it was investigated how they could be useful for the project. This included also reading papers, implementing algorithms etc. Some algorithms can be mentioned such as different edge detectors (Canny) , phase correlation, FFT's, feature detectors (especially SIFT, SURF and Harris), RANSAC, Image filters etc etc. This included implementing in different environments. Besides using software I was already familiar with I learned how to use OpenCV and Scientific- and Numerical Python.

It should also be mentioned that I got new and valuable research contacts both at CNR but also in the two visits for research exchange. The aim is to develop and maintain these collaboration opportunities.

II- Publication(s) during your fellowship

Please insert the title(s), author(s) and abstract(s) of the published paper(s). You may also mention the paper(s) which were prepared during your fellowship period and are under reviewing.

Three papers were written during the fellowship period. The first two were also published during the period and the third is published after the period:

TITLE: Retrospective Illumination Correction of Greyscale Historical Aerial Photos
AUTHORS: Anders Hast, Andrea Marchetti
ABSTRACT: Illumination correction is a method aiming at removing the influence of light from the environment and other distorting factors in the image capture process. A novel algorithm based on luminance mapping is proposed that both removes the low frequency variations in intensity as well as increases the contrast in low contrast areas. Moreover, it avoids the common problems with homomorphic filters. This algorithm is being applied on historical aerial photos with good results.

TITLE: Geomemories - a Spatial-Temporal Atlas of the Italian Landscape
AUTHORS: A. Marchetti, A. Hast, B. Rapisarda, E. J. Shepherd and M. Tesconi
ABSTRACT: The AeroFototeca Nazionale of the Italian Ministry of Cultural Heritage in Rome maintains an extensive set of some million aerial photographs constituting an important memory archive of the Italian territory throughout the 20th century. Together with the Institute of Informatics and Telematics of CNR in Pisa the GeoMemories project was launched with the aim of creating a web platform covering spatial-temporal dimensions and also integrating multimedia data from other archives that displays the evolution of the Italian Landscape. We present some challenges of the project and achievements so far as well as examples of how the tool presented here has a great potential to become a valuable resource for both historians and archaeologists.

TITLE: PUTATIVE MATCH ANALYSIS - A REPEATABLE ALTERNATIVE TO RANSAC FOR MATCHING OF AERIAL IMAGES
AUTHORS: Anders Hast and Andrea Marchetti

ABSTRACT: One disadvantage with RANSAC is that it is based on randomness and will therefore often yield a different set of inliers in each run, especially if the dataset contains a large number of outliers. A repeatable algorithm for finding both matches and the homography is proposed that will yield the same set of matches every time and is therefore a useful tool when trying to evaluate other algorithms involved and their parameters.

One paper (extended abstract) was written and published during the fellowship period that describes research conducted before the fellowship period:

TITLE: Multiscale Texture Synthesis - on Different HPC Platforms
AUTHOR: Anders Hast

One paper was almost finished during the fellowship period that is the extension of the first paper published (Illumination correction) and contains new research results. It will

be submitted to a Journal this winter.

Finally a paper will be written this winter that contains research results obtained during the fellowship period and the goal is to submit it to a conference and perhaps it will be extended later to be submitted to a Journal. This paper deals with a modified version of RANSAC that is both faster and finds all inliers every time.

III -Attended Seminars, Workshops, and Conferences

I presented a short paper at the International Symposium on Virtual Reality, Archaeology and Cultural Heritage VAST2011 in Prato, Italy. The paper is entitled: Geomemories a Spatial-Temporal Atlas of the Italian Landscape. I was also chairman of a full paper session at the conference. 18-21 October 2011.

I presented a poster at The International Conference on Image Analysis and Processing ICIAP2011 in Ravenna, Italy. The poster is entitled: Retrospective Illumination Correction of Grayscale Historical Aerial Photos. 14-16 September 2011.

I presented a poster at the Transnational Access Meeting in the HPC-Europa2 project. The meeting was held at BSC in Barcelona. The poster is entitled: Multiscale Texture Synthesis on Different HPC Platforms. This was the result of previous work and was reimbursed by HPC-Europa2. 7-8 June 2011.

I attended the workshop "Sotto la Superficie - Archeologica urbana A Pisa. 3 June 2011. Pisa, Italy.

I attended the workshop Content on the Multilingual Web, 4-5 April 2011. Pisa, Italy.

IV – Research Exchange Programme (12 month scheme)

Department of Pattern Recognition, Institute of Information Theory and Automation, Academy of Sciences of the Czech Republic.
Michal Haindl, Department of Pattern Recognition, Prague. Arrival 21 March 2011. Departure 30 March 2011.

Institute for Computer Graphics and Vision, Graz University of Technology, Inffeldgasse 16, 8010 Graz, Austria.
Andreas Wendel, Institute for Computer Graphics and Vision, Graz. Arrival 6 November 2011, Departure 12 November 2011.