

SEMINAR 1

Professor Wojciech Chojnacki

Time: **10.30am**

Venue: **B21 Teaching Suite 5**

Title:

Multiple Homography Estimation Using Latent Variables

Abstract:

An approach will be presented to estimating a set of interdependent homography matrices linked together by latent variables. A critical feature of the approach is that it allows enforcement of all underlying consistency constraints. The input data used in this approach takes the form of a set of homography matrices individually estimated from image data with no regard to the consistency constraints, appended by a set of error covariances, each associated with a corresponding matrix from the previous set. A statistically-motivated cost function will be presented for upgrading, via optimisation, the input data to a set of homography matrices satisfying the constraints. An optimisation algorithm for this problem will be discussed that operates on natural underlying latent variables, the use of those variables ensuring that all consistency constraints are satisfied. The algorithm outperforms previous schemes proposed for the same task and is fully comparable in accuracy with the 'gold standard' bundle adjustment technique, rendering the whole approach both of practical and theoretical interest.

Bio:

Professor Wojciech Chojnacki is a Senior Research Fellow in the School of Computer Science at the University of Adelaide working on a range of problems in computer vision. His research interests include differential equations, mathematical foundations of computer vision, functional analysis, and harmonic analysis.

SEMINAR 2

Dr Andrew Comport

Time: **2.00pm**

Venue: **B21 Teaching Suite 5**

Title:

Dense visual localisation and mapping in real-time

Abstract:

This talk will present an asymmetric model for realtime dense localisation and mapping. In a first part it will be shown how large-scale dense photometric models are acquired using RGB-D sensors including both multicamera and Kinect devices. In a second part it will be shown how different sensors may then be used with these prior models to perform robust localisation in dynamic environments including a monocular, stereo or Kinect sensor. The proposed approach to handling dynamic changes in the scene involves combining the prior dense photometric model with online visual odometry. In particular it will be shown how the technique takes into account large illumination variations and subsequently improves direct techniques which are intrinsically prone to illumination change. This is achieved by exploiting the relative advantages of both model-based and visual odometry techniques for tracking. In the case of direct model-based tracking, photometric models are usually acquired under significantly greater lighting differences than those observed by the current camera view, however, model-based approaches avoid drift. Incremental visual odometry, on the other hand, has relatively less lighting variation but integrates drift. To solve this problem a hybrid approach is proposed to simultaneously minimise drift via a 3D model whilst using locally

consistent illumination to correct large photometric differences. Direct 6 dof tracking is performed by an accurate method, which directly minimizes dense image measurements iteratively, using non-linear optimisation.

Several systems for automatically acquiring the 3D photometric model will be presented including a 6 camera system, a stereo system and a kinect device. Real experiments will be shown on complex 3D scenes for a hand-held camera undergoing fast 3D movement and various illumination changes including daylight, artificial-lights, significant shadows, non-Lambertian reflections, occlusions and saturations. Results will be shown using this approach for autonomous navigation of a mobile vehicle.

Bio:

Dr. Andrew Comport is "Chargé de Recherches" (tenure researcher) with the Centre National de Recherche Scientifique (CNRS) in France. He is associate director of the Signal-Image-Systems (SIS) department of the I3S laboratory at the University of Nice Sophia-Antipolis since 2009 where he leads research on localisation and mapping by vision. He currently participates in the national projects Fraudo-Rapid (autonomous obstacle traversal), ANR CityVip (autonomous visual navigation in urban environments) and FUI ADOVIC (visual servoing of drones for inspection of structures). He collaborates with several national academic partners INRIA, LASMEA, LAAS, ONERA and international partners Australian National University, CTI Division of Robotics and Computer Vision, Brazil and the Lappeenranta University of Technology, Finland. He also works with the industrial partners Thales Alenia Space, Astrium, ECA and Infotron. Before he was member of the LASMEA laboratory at the University of Blaise Pascal. From 2005 to 2007, he carried out a posdoc in the AROBAS team at INRIA Sophia-Antipolis financed by the ANR MOBIVIP project, where he studied stereo visual odometry for the navigation of mobile robots. In 2005, he obtained a PhD degree from IRISA/INRIA Rennes on the topic of 'Robust real-time 3D tracking of rigid and articulated object for augmented reality and robotics'. In 2001, he worked as research assistant at the Intelligent Robotics Research Center (IRRC) at Monash University in Australia. In 2000, he obtained a Bachelor of Engineering (BE) majoring in Electrical and Computer Systems Engineering with Honours at Monash University. In 1997, He obtained a Bachelor of Science (BSc) majoring in Computer Science also from Monash.

Webpage:

<http://www.i3s.unice.fr/~comport/>

SEMINAR 3

Professor Kenichi Kanatani

Time: **3.30pm**

Venue: **B21 Teaching Suite 5**

Title:

Renormalization returns! Hyper-renormalization and its applications

Abstract:

In the domain of statistics, two approaches exist for estimation from sampled data: the minimization approach and the "estimation equation" approach. The former minimizes some cost function, e.g., the negative logarithmic likelihood for maximum likelihood (ML). The latter directly specifies equations to solve, not necessarily the gradient of any function. In the domain of computer vision, however, the former, typically reprojection error minimization, seems to be the norm for geometric estimation. An exception is renormalization. It does not minimize any cost function; it directly specifies the problem to solve, a generalized eigenvalue problem, to be specific. For this reason, it has often been regarded as suboptimal, but this approach is more general and flexible in the sense that we can design the problem so that the solution has the highest accuracy by doing detailed error analysis.

We show that the renormalization approach can be modified so that the resulting solution has zero bias up to higher order error terms. We call it "hyper-renormalization" and show by experiments that it outperforms the FNS of Chojnacki et al. (2000) or reprojection error minimization. This is currently the best method available for geometric estimation.

Bio:

Prof Kenichi Kanatani is Professor of Computer Science at Okayama University, Japan. His research career started with studies of theoretical continuum mechanics (elasticity, plasticity, and fluid) and its application to mechanics of granular materials such as powder and soil, but his research interest has shifted to mathematical analysis of images and 3-D reconstruction from images. Currently, he is devoted to mathematical analysis of statistical reliability of computer vision and optimization procedures. He has been a visiting researcher at the University of Maryland, U.S.A., the University of Copenhagen, Denmark, the University of Oxford, U.K., and INIRA at Rhone Alpes, France.

Prof Kanatani is the author of "Group-Theoretical Methods in Image Understanding" (Springer, 1990), "Geometric Computation for Machine Vision" (Oxford University Press, 1993) and "Statistical Optimization for Geometric Computation: Theory and Practice" (Elsevier Science, 1996).

Prof Kanatani has received many awards, including:

- Information Technology Promotion Award of Funai Foundation for Information Technology in 2005
- Best Paper Award of IEICE (Institute of Electronic, Information and Communication Engineers) in 2005.
- Information and System Society Activity Service Award of IEICE (Institute of Electronic, Information and Communication Engineers) in 2005.
- Best Paper Award of the Pacific-Rim Symposium on Image and Video Technology (PSIVT'09), Tokyo, Japan, January 2009.
- Most Influential Paper over the Decade Award, IAPR Conference on Machine Vision Applications 2009, Japan, May 2009.

He received his B.S., M.S., and Ph.D. in Applied Mathematics from the University of Tokyo, Japan, in 1972, 1974, and 1979, respectively. He joined the Department of Computer Science, Gunma University, Kiryu, Japan, in April 1979 as Assistant Professor. He became Associate Professor and Professor there in April 1983 and April 1988, respectively. From April 2001, he has been the Professor of Computer Science at Okayama University. He was elected IEEE Fellow in 2002.

All seminars will be held in the basement of the Innova 21 Building, North Tce Campus.