Ninth International Conference in Computer Vision (ICCV), Nice 2003.

Short Course: Learning and Inference in Vision: Generative Methods (3½ hours).

Presenters: **Bill Freeman** (MIT AI Laboratory) and **Andrew Blake** (Microsoft Research Cambridge)

(0) Intro – roadmap for learning and inference in vision

(1) Bayesian inference introduction; integration of sensory data
applications: color constancy, Bayes Matte

(2) Learning and inference in temporal and spatial Markov processes
Techniques:

2.1 **PCA, FA, TCA**:
inference – linear (Wiener) filter
learning: by Expectation Maximization (EM); (tutorial: EM for 2-line fitting)
applications: face simulation, denoising, Weiss's intrinsic images
and furthermore: Active Appearance Models, Simoncelli, ICA & non-Gaussianity, filter banks

2.2 **Markov chain & HMM**:
inference: - MAP by Dynamic Programming, Forward and Forward-Backward (FB) algorithms;
learning: by EM – Baum-Welch;
representations: pixels, patches
applications: stereo vision
and furthermore: gesture models (Bobick-Wilson)

2.3 **AR models**:
Inference: Kalman-Filter, Kalman Smoother, Particle Filter;
learning: by EM-FB;
representations: patches, curves, chamfer maps, filter banks
applications: tracking (Isard-Blake, Black-Sidenbladh, El Maraghi-Jepson-Fleet); Fitzgibbon-Soatto textures
and furthermore: EP

2.4 **MRFs:**
Inference: ICM, Loopy Belief Propagation (BP), Generalised BP, Graph Cuts;
Parameter learning: Pseudolikelihood maximisation;
representations: color pixels, patches
applications: Texture segmentation, super resolution (Freeman-Pasztor), distinguishing shading from paint
and furthermore: Gibbs sampling, Discriminative Random Field (DRF)

2.5 **Bayes network:**
Inference: Belief Propagation (BP)
Parameter learning: Pseudolikelihood maximisation;
applications: scene context analysis: combine top down with bottom up (Murphy et al)

2.6 Markov network:
Inference: MCMC
applications: low level segmentation (Zhu et al.)

(3) Summary and finish

Biographies of Presenters.

Bill Freeman is an Associate Professor of Electrical Engineering and Computer Science at the Computer Science and Artificial Intelligence Laboratory (CSAIL) at MIT. From 1992 - 2001 he worked at Mitsubishi Electric Research Labs (MERL), and from 1981 - 1987, heworked at the Polaroid Corporation, both in Cambridge, MA. He obtained his PhD in computer vision in 1992 from MIT.

His current research interests include machine learning applied to computer vision, Bayesian models of visual perception, and interactive applications of computer vision. In 1997, he received the Outstanding Paper prize at the Conference on Computer Vision and Pattern Recognition for work on applying bilinear models to "separating style and content". Previous research topics include steerable filters and pyramids, the generic viewpoint assumption, color constancy, and computer vision for computer games. He holds 22 patents.

Andrew Blake has served on the on the faculty of Computer Science at the University of Edinburgh and as a Royal Society Research Fellow from 1983-7 and then on the faculty of the Department of Engineering Science in the University of Oxford, where he ran the Visual Dynamics Research Group, became a Professor in 1996, and and was a Royal Society Senior Research Fellow for 1998-9. In 1999 he moved to Microsoft Research Cambridge as Senior Researcher working in Machine Learning and Perception, while continuing with the University of Oxford as Visiting Professor of Engineering.

He has published several books including "Visual Reconstruction" with A.Zisserman (MIT press), "Active Vision" with Alan Yuille (MIT Press) and "Active Contours" with Michael Isard (Springer-Verlag). He has twice won the prize of the European Conference on Computer Vision, with R. Cipolla in 1992 and with M. Isard in 1996, and was awarded the IEEE David Marr Prize (jointly with K. Toyama) in 2001. He has served as programme chairman for the International Conference on Computer Vision in 1995 and 1999, and is on the editorial boards of the journals "Image and Vision Computing", the "International Journal of Computer Vision" and "Computer Vision and Image Understanding". He was elected a Fellow of the Royal Academy of Engineering in 1998.