

**Title:** Mini-workshop on 'Higher level scene understanding and application in robotic vision'.

**Place & Date:** The George Hotel, 19-21 George Street, Edinburgh, EH2 2PB || March 19-20, 2016.

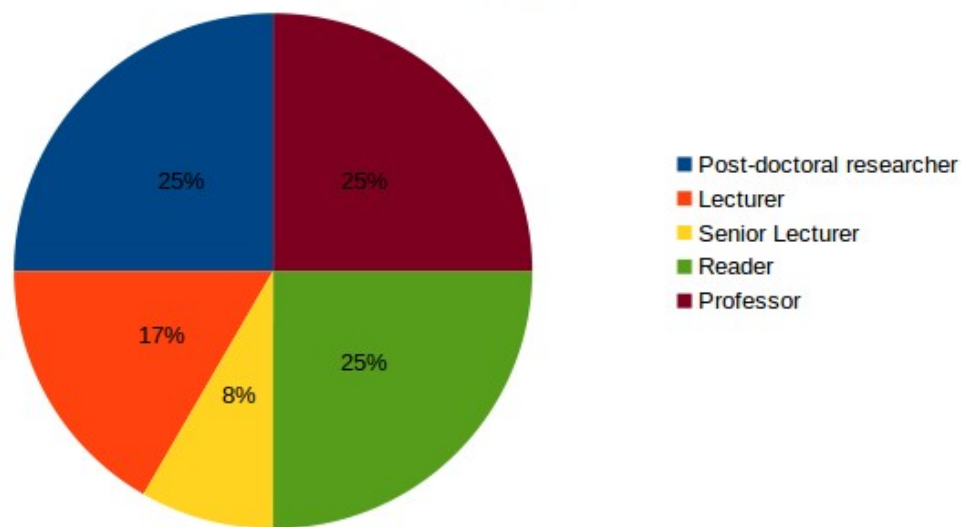
**Summary:**

A two day mini-workshop was held in Edinburgh on the sub-theme titled 'Higher level scene understanding and application in robotic vision' under the interdisciplinary ViiHM themes. The mini-workshop differed from traditional presentation style workshop structure and aimed to engage participants by a number of brainstorming sessions and discussions in a non-academic setting (a meeting of minds). The workshop was pleasantly successful if measured by the responses received for participation, diversity of the participants and the quality of the discussions during the workshop.

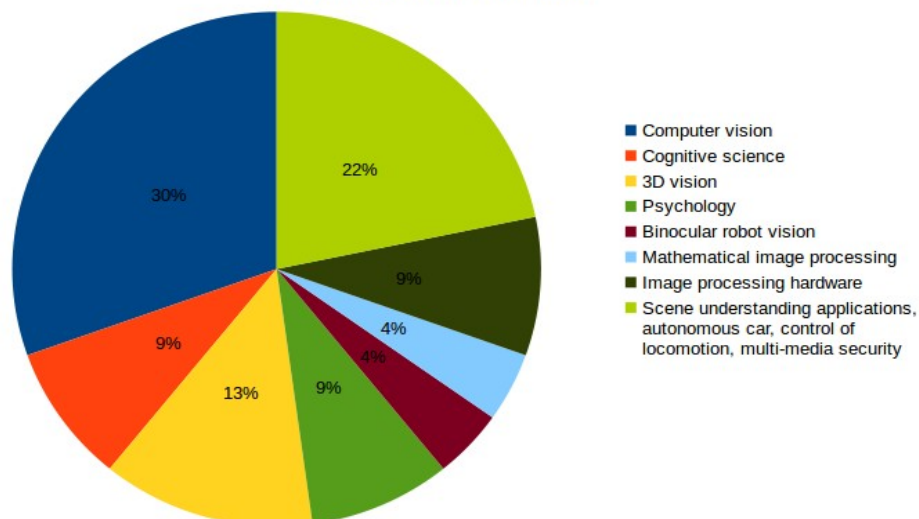
**Participants details:**

Although a good number of responses were received to participate in the workshop, we had to restrict the number to maximum twelve in order to keep this as an interactive brain-storming / discussion forum. Our participants represent a good cross section of the disciplines, i.e., computer vision, cognitive science & psychology, are at various stages of their academic career including post-doctoral researchers, lecturers, readers and professors from the universities across UK. Bellow is representative statistics of the participants. A detail list is provided at the end of this document.

Participants' career profile



Subject area of the participants



## **Discussion topics and presentations:**

The workshop had two guest lectures, one everyday, presented by Prof Fred Stentiford, UCL, London and Prof Andrew Wallace, Heriot-Watt University, Edinburgh, and a series of brain storming sessions.

Generally understanding salience, eye movements, visual processing requires input from computer science, psychology and cognitive science but also embodied systems such as robotics, real time visual processing hardware. This workshop brought together researchers from various backgrounds to exchange ideas and discuss various research challenges and opportunities. Following broad range of research topics were discussed:

- a) Initially we spend a good amount of time to outline a set of definitions that may describe '*visual attention*' from various research prospective.
- b) Although visual saliency research emerged really quickly in past couple years, the computational models are far from perfect. Our quest is to derive a better model for visual saliency estimation. This requires a strong interdisciplinary effort from researchers in psychology, cognitive computing and computer vision.
- c) Empirical studies from the human vision side of the literature point towards the importance of high-level features such as objects and tasks. While low level salience plays an important role, a full understanding of salience and eye movements and visual processing will come from human/machine collaborations to integrate both bottom-up salience and top down factors.
- d) The higher level understanding of the scene can also be useful in saliency based behavioural study in public space. How does scene visual attention impact on human behaviour or movement in public space? Will this be useful for anomaly detection relating public safety?
- e) Robotics was identified as one of the priority research areas by UKRC. The application of visual saliency based scene understanding in robotic vision including control for locomotive can offer interesting research directions such as Bayesian approaches that can set up prior expectancies of where items of interest may be, and so can act as 'expectation maps' which modulate bottom-up salience.
- f) Lack of available labelled datasets is a big challenge in visual saliency research. Although a number of image datasets are available only a handful of video datasets are publicly accessible. New data sets that are suitable for robotic vision research i.e. videos of moving objects captured from moving platform, is equally important.
- g) Visual saliency models are often complex in nature and require significant computational resources thus limiting applications that need remote real-time processing e.g., mobile robots, unmanned aerial vehicles (UAV). Research efforts are needed for an accelerated, power efficient embedded visual processing hardware e.g. FPGAs.

## **Impact:**

We agreed to write a multi-discipline review or summary paper (targeting in next 6 months) and formed interdisciplinary collaboration for future proposal submission. The workshop was well received by all participants and follow on workshops are planned in every six months.

### **Organising members:**

Dr. Deepayan Bhowmik (Lead member)

(Research Associate, Heriot-Watt University, Edinburgh)

Research domain: Robotic vision, accelerated image processing hardware, visual saliency modelling and applications.

Dr. Benjamin Vincent (Lecturer, University of Dundee)

Research domain: Psychology, Visual processing and attention, Bayesian decision theory.

Dr. Alasdair Clarke (Research Fellow, University of Aberdeen)

Research domain: Psychophysics, Cognitive Science, Cognitive Psychology.

Dr. Charith Abhayaratne (Lecturer, University of Sheffield)

Research domain: Image and video coding, low-level visual feature extraction, content based image retrieval and its applications.

### **Details of workshop participants:**

Name	University	Research Domain
Fred Stentiford	UCL	Saliency, Face recognition
Andrew Wallace	Heriot-Watt University	Computer vision, Vision for Autonomous Vehicle
Bob Fisher	University of Edinburgh	3D scene understanding
Paul Siebert	University of Glasgow	3D vision, Cognitive Science and binocular robot vision
Alexander Belyaev	Heriot-Watt University	Mathematical image processing
Kun Guo	University of Lincoln	Psychology
Kasim Terzic	Queen Mary, University of London	Computer vision
J F Burn	University of Bristol	Vision for control of locomotion
Benjamin Vincent	University of Dundee	Psychology
Charith Abhayaratne	University of Sheffield	Computer Vision, Image processing
Alasdair Clarke	University of Aberdeen	Cognitive Science
Deepayan Bhowmik	Heriot-Watt University	Computer vision and imaging hardware