

# Centre for Image Processing & Analysis



Vision Systems

Quantitative Image Analysis

Medical Imaging

Acquisition & Visualization

The Centre for Image Processing and Analysis (CIPA) is comprised of researchers in DCU along with a range of Industrial and Biomedical partners. CIPA acts as the focus for **Image Processing & Quantitative Image Analysis** research in DCU. CIPA/VSG was a founding member **RINCE - an Irish national research institute focussed on innovation in engineering** (a €10.4 million HEA-PRTL I initiative) and is one of 3 research centres that currently constitute **RINCE**. CIPA was also founding member of the **NBIP - National Biophotonics & Imaging Platform** (a €30 million HEA-PRTL IV initiative) and the recently funded (PRTL V, €23.8 million) **Nano-Bioanalytical Research Facility**.

Our digital and non-digital IPA research programmes relate to issues involved in the **acquisition (custom sensor design), processing, quantitative analysis, classification, visualisation and systems engineering (integration) for a wide range of computer vision applications**. Specifically the group focuses on the issues involved in the automation or semi automation of **image feature segmentation**, and its associated **quantitative analysis**, at both a micro and macro level.

At the core of CIPA is the Vision Systems Group (VSG). The VSG was formed in 1990 by Prof. Paul Whelan, as a forum to co-ordinate and support the promotion of computer and machine vision research in DCU. In 1999 Prof. Whelan formed the Medical Imaging Laboratory as a focus for medical imaging research within DCU. The Vision Systems Group currently consists of a core team working on computer vision (specifically image segmentation), medical imaging (specifically computer aided detection / diagnosis) and their associated visualization projects. In addition to the VSG team we have 4 adjunct faculty members based in the Mater hospital and RCSI.

The **core expertise** provided by the Vision Systems Group in DCU is in its ability to develop and design novel computer based solutions that will allow the **automatic extraction of key image features [specifically from 2D, video, 3D and 4D data sources]** with a view to a **robust and reliable quantitative analysis of the key information/data within the scene**. As well as undertaking applied and basic research into a range of imaging problems, the VSG is also involved in the transfer of computer and machine vision techniques from the research environment to Irish industry and hospitals. CIPA's current research programmes can be divided into three main categories namely *Traditional Computer Vision Research*, *Industrial/Machine Vision* and *Biomedical Computer Vision (Computer Aided Detection and Diagnosis focusing on translational research)*.

## Traditional Computer Vision

Calibration of non-conventional cameras and the removal of optical aberrations in digital imaging systems.

## Industrial/Machine Vision

Development of fundamental mathematical models for colour and texture integration.

## Biomedical Computer Vision

The key aim of this programme is to **develop diagnostic computer vision tools for translational research focusing on ever earlier stages of the disease manifestation** i.e. from **surface** imaging (analysis of three-dimensional facial dysmorphology) to **organ** imaging (white matter volume assessment) to **cell** (automatic tracking of cell) and **sub cell** imaging (automated segmentation/classification of mitochondria from TEM).

CIPA/VSG was a founding member of **Irish Pattern Recognition and Classification Society (IPRCS)**. We gratefully acknowledge the support of the following: EU Fifth Framework Programme IST: Accompanying Measures; Motorola; Hewlett-Packard; Amdahl; Agilent-Ireland; Technology Systems International Ltd.; Tegral; Forbairt; European Commission: Framework IV; EOLAS/British Council; DCU Research Committee; DCU Educational Trust; RINCE; Irish Cancer Society; Mater Hospital; National Rehabilitation Board; Private Donors; Albert College Junior and Senior Fellowships; Health Research Board; Irish Research Council for Science; Engineering and Technology (IRCSET); NBIP; Enterprise Ireland (C+, Tech Dev, POC, ARGS); Irish Higher Education Authority (PRTL I, IV, V); Wellcome Trust; Temple Street Children's Hospital; Industrial partners and Science Foundation Ireland (PI & RFP).

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## Education & Outreach

The Vision Systems Group run a wide ranging **Education & Outreach** programme covering undergraduate & graduate education along with undergraduate internships and outreach into second level education.

### 2nd Level:

**SFI Secondary Teacher Assistant Researcher (STAR).** "My experience in DCU has been both enjoyable and interesting. I have learnt a great deal, not only about the research been done but also the skills and competencies needed to be a researcher"

### 3rd Level:

**EE425 / EE453 - Image Processing & Analysis / with Project:** Most people are familiar with the concept of processing an image to improve its quality or the use of image analysis software tools to make basic measurements; but what are the ideas behind such solutions and why is knowledge of these concepts important in developing successful computer vision applications? This module will answer these questions by focusing on the practical issues associated with a wide range of computer vision solutions.

**NBIPMOD1 - Fundamentals in Image Processing and Analysis:** Focusing on both the theoretical, mathematical and practical issues associated with the fundamentals of image processing and analysis (IPA) with a focus on the life sciences.

### Internships:

**SFI UREKA (Undergraduate Research Experience & Knowledge Awards).** "This project gave me the opportunity to work in a team and I will be willing to pursue research in the area of machine vision in the future. Maybe what was most beneficial to me was that I learned to put into practice the knowledge that I have obtained"... "The fulltime research environment was a departure from the undergraduate student situation. It was a chance to apply myself for a period of time to some real engineering challenges"

### Graduate Education:

**Major in Image Processing & Analysis within the Masters in Electronic Systems.** This Major will prepare graduates to specialise in the areas of image processing and analysis, computer & machine vision, biomedical imaging and image synthesis techniques. Students taking this Major will study from a selection of IPA modules including:

**EE544 - Computer Vision:** The focus of this module is to produce graduates with a deeper theoretical understanding of the issues that underpin computer vision.

**EE563 - 3-D Graphics & Visualisation:** This course examines 3D scientific visualisation and visualisation technologies from an engineering viewpoint.

**EE554 - Image and Video Compression:** The aim of this module is to introduce graduate-level students to the theory, technology and standards of image and video compression.

**EE595 - Imaging Major Project:** To allow the student to put theoretical knowledge of engineering to use in a practical project and to document the project outputs to research publication standard.

**IRCSET PhD Studentships:** CIPA currently hosts a number of IRCSET funded PhD students.

### General Public:

CIPA makes a large amount of its software (**NeatVision & VSG IPA Matlab Toolbox** ) freely available to both the public and the wider scientific community.

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