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Science Bridges China Research Profile

Name: **Dr. David Connah**

Position: **Research associate**

Institute/division: **Centre for Visual Computing**

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SUMMARY OF MY RELEVANT RESEARCH AREAS:

The Centre for Visual Computing brings together research in computational, mathematical and perceptual aspects of vision. Our areas of expertise include image processing, computer graphics, visual perception, 3D visualization and knowledge representation.

视觉计算机中心汇集计算机，数学和视觉的感性方面的的研究。我们的专业领域包括图像处理，计算机图形学，视觉感知，三维可视化和知识表示。

Primary Research interests:

I represent the Centre for Visual Computing, a multidisciplinary Research and Knowledge Transfer Centre, which brings together research in computational, mathematical and perceptual aspects of vision. We have applied our know-how in many different problem domains, from healthcare (computer assisted diagnosis) to security (facial analysis and recognition), space weather research (automatic detection of solar flares / solar modelling) and in perceptual research, particularly how people process and combine colour and depth information when forming their view of the world. The CVC is a multidisciplinary research institute, with core members whose expertise overlaps in certain key areas: **Image analysis:** focuses on the development of real-time algorithms for classification, prediction and detection of image features. Prof. Rami Qahwaji and co-workers have developed methods for the automatic detection and classifIcation of sun-spots from multispectral images of the sun, and used this information to predict the probability of solar flare activity. The techniques used include noise removal, feature detection, and then machine learning to perform the classification. Prof. Qahwaji has also applied similar approaches to medical imaging in the development of computer assisted diagnostic techniques for the detection of breast-cancer. Other image analysis work at the CVC, led by Prof. Hassan Ugail, has looked at the automated analysis of faces, and has applied these techniques to building a system for profiling individuals based on their intent (e.g. whether they are lying or telling the truth). **3D modelling and representation:** Prof. Ugail and co-workers have made significant developments in mathematical approaches to 3D representation, specifically those based on the PDE method. The PDE method allows high-volume 3D point-clouds to be reduced to a small number of parameters, which both allows the data to be compressed and gives a compact representation that can be used in recognition and retrieval applications. This approach has been applied to reducing download times in online-gaming applications, modelling different shapes in 3D, and in recognising faces from 3D data. **Visual perception:** Perceptual research, led Dr. Marina Bloj, looks at the interaction of different visual cues, and how these shape our perception of surfaces, objects, and rendered scenes. Some of this is basic research that looks at how colour gradients can affect depth perception (and how changes in depth can influence colour) while work on rendered scenes has led to practical applications including the evaluation of high-dynamic range displays, comparing different computational algorithms for image fusion, and measuring the realism of 3D graphical renderings by comparing rendered scenes with the real world.

Topics in which you would like to develop collaborative research:

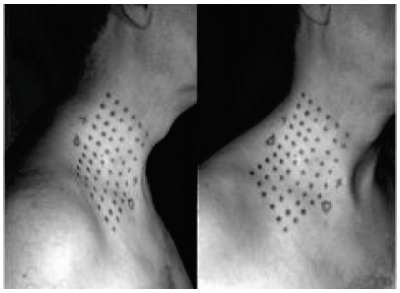
3D modelling, image analysis, visualisation, and application of perception to problems in graphics and visualisation.

Relevant existing collaborations (academic/clinical/commercial) inside or outside China.

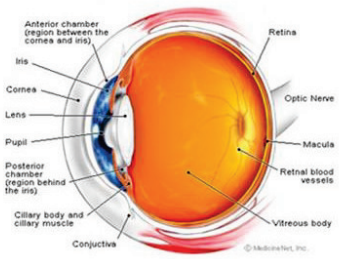
Visual computing has many ongoing collaborations with Universities, both nationally and internationally, including: University of Cambridge, University of Bath and University of Bournemouth (mathematical modelling for data representation and compression); Nanyang Technological University, Singapore, (3D image analysis and virtual environments); University of St Andrews (depth perception in real and computer-generated scenes); Aberystwyth University (Facial profiling and thermal imaging); Leeds University (mathematics of geometrical modelling); University of York (analysis of plant growth); and the University of East Anglia (colour to greyscale algorithm development). We also have commercial projects ongoing with a range of companies, most notably Tangentix (Gaming applications of mathematical 3D modelling), Croda (hair and skin cosmetics), NASA and ESA (space-weather research).

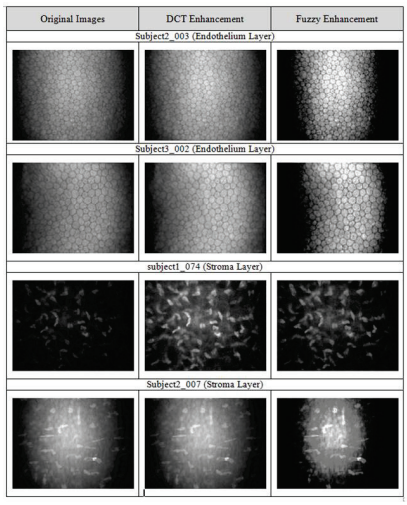
Relevant graphics, figures, pictures:

For pictures and graphics relevant to research, please go to:
www.visualcomp.co.uk



Analysing 3D Images of Skin and Wounds





3D Modelling of the Cornea

Publications and other outputs relevant to your interest in this programme (up to 5)

- Ahmed O, Qahwaji R, Colak T, Higgins P, Gallagher P, Bloomfield S (2011): “Solar Flare Prediction using Advanced Feature Extraction, Machine Learning, and Feature Selection.” Solar Physics, Special Issue on Solar Imaging, DOI: 10.1007/s11207-011-9896-1.
- Harding G, Harris JM, and Bloj M (2012). "Learning to use Illumination Gradients as an Unambiguous Cue to Three Dimensional Shape." PLoS ONE, 7(4), e35950. doi:10.1371/journal.pone.0035950
- Lovell PG, Bloj M, and Harris JM (2012). "Optimal integration of shading and binocular disparity for depth perception." Journal of Vision, 12(1):1, 1-18, doi:10.1167/12.1.1
- Ugail H, Márquez M and Yilmaz A (2011): "On Bézier Surfaces in Three-Dimensional Minkowski Space" Computers and Mathematics with Applications, 62 2899–2912.
- Arnal A, Monterde J and Ugail H (2011): "Explicit Polynomial Solutions of Fourth Order Linear Elliptic Partial Differential Equations for Boundary based Smooth Surface Generation" Computer Aided Geometric Design, 28 (6): 382-394.