

## EDUCATION CORRESPONDENCE

**Anatomy from the outside in: a new on-line surface anatomy guide**

Surface anatomy is important in clinical practice, painting and drawing but is often poorly taught. A unique collaboration between anatomists, engineers and artists produced a 6-min trailer, the centrepiece of an art exhibition, and a 4 h on-line teaching tool which has been successfully used over three continents for the past 4 years. Both are now offered on-line, free of charge, to facilitate surface anatomy teaching (<http://www.rcsi.ie/SurfaceAnatomy>).

Medical students are reluctant models, so getting one to take off his shirt to demonstrate the surface anatomy of the heart valves can be a challenge. Yet surface anatomy is the basis of clinical examination and students must learn where to listen to the heart, the markings of the liver, the sites of incisions and the movements of joints – in short the site of everything from the outside in. Artists and art students don't always have access to a live model either, and for them, knowledge of the underlying skeletal and muscular structures is fundamental to drawing and painting the figure.

Computer-aided learning offered an elegant solution and so, in 2009, anatomists from the Royal College of Surgeons in Ireland (RCSI), engineers from Trinity College Dublin (TCD) and artists from the Royal Hibernian Academy (RHA) began a 2-year collaboration sponsored by Science Foundation Ireland and RCSI. The result was an on-line *Surface Anatomy Guide* in 3D which shows the motions of muscles and the sites of structures from the surface inwards. This 4-h teaching programme has been used by medical students in Dublin, Bahrain and Kuala Lumpur, by physiotherapy students in Dublin, by surgical trainees in Ireland, and in the 10 countries of the College of Surgeons of East, Central and Southern Africa – Burundi, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe – and as the basis for teaching anatomy to artists in the RHA School.

Anil Kokaram and Clive Lee previously worked together on an on-line *Dissection Guide*, and applied to SFI for a grant to extend this to Surface Anatomy and utilise stereo-3D technology. The grant application was successful and engineer David Corrigan from TCD and medical graduate Valerie Morris from RCSI joined the team to script, shoot and edit the *Guide*. Mick O'Dea made the RHA studios available for the shoot and, together with Una Sealy, joined

in the editing process to ensure that the *Guide* would be applicable to artists as well as to medical and physiotherapy students and surgical trainees.

Stereo-3D or stereoscopic photography is not new. Stereoscopic pictures of Dublin can be found in the National Library of Ireland dating from 1865, but it is only recently that 3D content on the big screen has been possible. However, it is still challenging to shoot in stereo-3D as the crew must work with two cameras mechanically and electronically coupled to each other and the camera sensors can never be the same. This is bad for stereo-3D viewing and tends to make people feel ill. The engineering challenges centre on fixing the pictures in post-production using signal processing algorithms developed by the engineers at Trinity. The artistic/educational challenge is in knowing how best to compose the shot so that the 3D-stereo effect gives meaningful information to the student and is not just a gimmick. The team worked together to solve many of these problems, finding that perspective was even more important in stereo-3D than in conventional photography, as well as integrating the novel algorithms into industry-standard software to ease the post-production process. It is interesting to note that the final cut was created using a framework that was also used in 3D action movies such as *Avatar* and *X-Men*.

*Anatomists, Engineers & Artists* is a trailer from the *Surface Anatomy Guide* and was the centrepiece of an exhibition in the Friends' Room, RHA, in December 2011. It uses anaglyph 3D images, which contain two differently filtered coloured images, one for each eye. When viewed with red (left) and cyan/blue (right) glasses, each image reaches the eye it is intended for and the visual cortex of the brain fuses this into a perception of a 3D structure. The timing of the exhibition was fortunate, as it was a rare good news story the day after an austerity budget and was featured on the Irish Six O'Clock News.

The full 4-h *Surface Anatomy Guide* has been very well received by undergraduate and graduate students alike across three continents over the past 4 years. We are now pleased to make our Surface Anatomy Guide available as freeware from our website in both 2D and 3D formats, the latter requiring anaglyph glasses. It shows how, by using movement, colour, illustration and 3D technology, anatomo-

mists, engineers and artists can collaborate to teach the body from the outside in. We hope that others find it helpful in teaching surface anatomy.

V. B. Morris,<sup>1,\*</sup> D. Corrigan,<sup>2,\*</sup> U. Sealy,<sup>3,\*</sup>  
A. Kokaram,<sup>2,†</sup> M. O'Dea,<sup>3,†</sup> and T. C. Lee<sup>1,3,†</sup>

<sup>1</sup>*Department of Anatomy Royal College of Surgeons in Ireland Dublin, Ireland* <sup>2</sup>*Department of Electronic and Electrical Engineering Trinity College Dublin, Ireland*  
<sup>3</sup>*Royal Hibernian Academy of Arts, Dublin, Ireland*

*\*Joint first authors.  
†Joint senior authors.*