

TCD Innovation Bursary Project: TRB04

The Book of Kells - Analysis of Style and Design Through the Application of Techniques in Non-photorealistic Rendering

The Book of Kells, which is widely regarded as the most ornate and famous illuminated manuscripts in the world, represents the greatest treasure in the Trinity College Library. Wonderfully painted on almost every page, it contains the four Christian Gospels together with various prefatory texts and tables, the whole work created by Celtic monks ca. 800 AD.

This multidisciplinary research project will tackle some long standing problems associated with the style and design of decoration within the Book through the use of digital media. Employing methods from the field of Non-photorealistic Rendering (NPR), specific stylistic and design features will be captured and analysed, with the aim of exploring geometrical patterns and compositions, colour palettes and material properties, as well as visceral mood and style. The aim is to place traditional methods of analysis employed by the art historian on a deeper, more objective and scientific basis. The project will provide an innovative approach to long standing problems, while at the same time giving the Book itself a new and more dynamic relevance in 21st century society.

Funding is available to cover fees and maintenance for a **4 year PhD Student** to undertake the major research work on this project. The intended start date for the project is **October 2010**.

Objectives

The goal of this project is to develop innovative techniques for the segmentation, interactive rendering and visualisation of digitally scanned imagery from the Book of Kells with the purpose of assisting in scholarly discovery of patterns in its style and design by art historians and art researchers (and secondarily by the lay public). Analysis and modelling of the styles, colours and techniques used in the creation of its pages will be used to capture and encapsulate elements of the visual design so that the essence of the book may be understood, segmented and possibly even procedurally reproduced in imagery and models.

This will involve working closely with Art Historians to determine the relevant facets of design and creativity that are of interest to scholars and artists, providing insights that should lead to the development of techniques for detection, segmentation, measurement and recreation of specific stylistic elements.

The technical challenges of the project fall within the fields of **Computer Graphics and Image Processing**, and may include

- analysis and modelling of the styles, colours and techniques
- semi-automatic assisted segmentation of image elements
- accurate modelling of material and surface properties of the vellum and pigments
- procedural creation of original imagery and digital content themed on the styles of the book
- analysis and modelling of wear and weathering on the inks and vellum to simulate how the original print may have looked like
- rendering imagery under varying simulated lighting conditions to simulate how the book was originally perceived upon creation (it is believed the pages were created by monks in severely under-lit conditions)
- development of techniques capable of facilitating collaborative, remote and online exploration that will reach and engage students and the general public

Some Related Works

The following is just a small sample of references in computer science literature covering the breadth of the topics from style modelling and analysis [1][5], assisted segmentation[6], pigment and weathering simulation[3][4], relighting[2]:

[1] Kaplan, M. and Cohen, E. 2003. Computer generated Celtic design. In *Proceedings of the 14th Eurographics Workshop on Rendering* (Leuven, Belgium, June 25 - 27, 2003). ACM International Conference Proceeding Series, vol. 44. Eurographics Association, Aire-la-Ville, Switzerland, 9-19.

[2] Tim Hawkins, T. Cohen, J. and Debevec, P. 2001. A Photometric Approach to Digitizing Cultural Artifacts. In 2nd International Symposium on Virtual Reality, Archaeology, and Cultural Heritage, Glyfada, Greece, November 2001.

[3] Small, D. 1991. Modeling watercolor by simulating diffusion, pigment, and paper fibers. In SPIE, vol. 1460, 140--146.

[4] Yanyun Chen, Lin Xia, Tien-Tsin Wong, Xin Tong, Hujun Bao, Baining Guo, and Heung-Yeung Shum. 2005. Visual Simulation of Weathering by γ -ton Tracing. ACM SIGGRAPH, 2005.

[5] Stork, D.G. 2007. Computer image analysis of paintings and drawings: An introduction to the literature. The 1st International Workshop on Image Processing for Artist Identification

[6] Sykora, D. Dingliana, J. and Collins, S. LazyBrush: Flexible Painting Tool for Hand-drawn Cartoons Computer Graphics Forum 28(2). pp. 599-608. April 2009.

Training and supervision

The successful candidate will be enrolled in a structured PhD program that will require the completion of 30 ECTS of MSc modules to be completed within the first 18 months of work, in parallel with initial research work. The student will be expected to take 10 ECTS from relevant Computer Science MSc courses (such as Real-time Rendering and Image Processing), the first semester of Early Irish Art for M.Phil students in the History of Art (10 ECTS) and 10 ECTS entrepreneurship modules from the Innovation Academy. Details of specific courses will be negotiated with supervisors based on the candidates previous background.

In History of Art the supervisor will be Professor Roger Stalley; in Computer Science, supervision will be provided by Dr John Dingliana. While the student will have regular contact with both supervisors, the two supervisors will meet together with the student on a regular basis to monitor progress.

The resulting training will be almost unique in the academic world – a graduate with combined expertise in both graphic visualization and a deep understanding of the issues associated with the study of ancient manuscripts.

Supervisor Profiles

Professor Roger Stalley: Roger Stalley has been Professor of the History of Art in Trinity College since 1990 and has collaborated with scholars outside his own immediate group (including a joint project with Computer Science on the analysis of architectural mouldings, funded by Enterprise Ireland). His principal expertise lies within the field of early medieval art, where he has published books and papers on architecture, sculpture and painting. He has lectured extensively on the problems of the Book of Kells and has supervised numerous PhD students during his career in TCD. (URL: http://www.tcd.ie/History_of_Art/staff/roger.php)

Dr John Dingliana: The co-PI is Dr. John Dingliana, a lecturer in Computer Science and a member of the Graphics Vision and Visualisation group, who been actively involved in leading edge research into the processing, synthesis and perception of digital images. Since 2005, he has been actively involved in various aspects of Non-Photorealistic Rendering research and currently has an SFI-RFP grant for the application of NPR to visualisations of Medical and Scientific Data. Additionally, he is a collaborator on an EU Marie Curie funded project investigating techniques for intuitive manipulation of scanned imagery in the animation industry. He is the course director of the MSc in Interactive Entertainment Technology and teaches courses in the MSc in Interactive Digital Media. (URL: <http://www.scss.tcd.ie/John.Dingliana/>)

Application Requirements

A student with at least an Upper Second Class Honours¹ degree from a computer science background with experience in computer graphics, image processing or computer vision is sought, although applications will be considered from students from related areas with sufficient experience in programming. Students should have an interest in art history or art and some formal background in these areas and prior knowledge of the Book of Kells would be beneficial. Applicants whose first language is not English and who have not been educated through the medium of English must present evidence of sufficient competence in the English language.

Applications are now open and are made through the Post-graduate Applications Center (<http://www.pac.ie/tcd>). See course code TRB04 under Innovation Bursaries.

For further information contact John.Dingliana@scss.tcd.ie

¹ An "Upper Second Class Honors degree" corresponds to an overall mark of at least 60% (or II.1) in your final degree examination or a Grade Point Average (GPA) of 3.5.