SHITSUKAN approach to digital colour sensing: human colour vision for material quality
8-9 August 2018, University of Manchester

The quality of digital colour images is often assessed by the realism and immersiveness of the images presented on a display screen. Major developments in new digital devices are required to achieve perceptual realism with digital images of natural objects in varying viewing conditions, such as the subtle changes in human skin colour or the pattern of light from leaves with water drops under changing daylight. As a longer-term goal to achieve rich and faithful colour representations, it is essential that we understand better how our visual systems process the information contained in light reflected from the natural world.
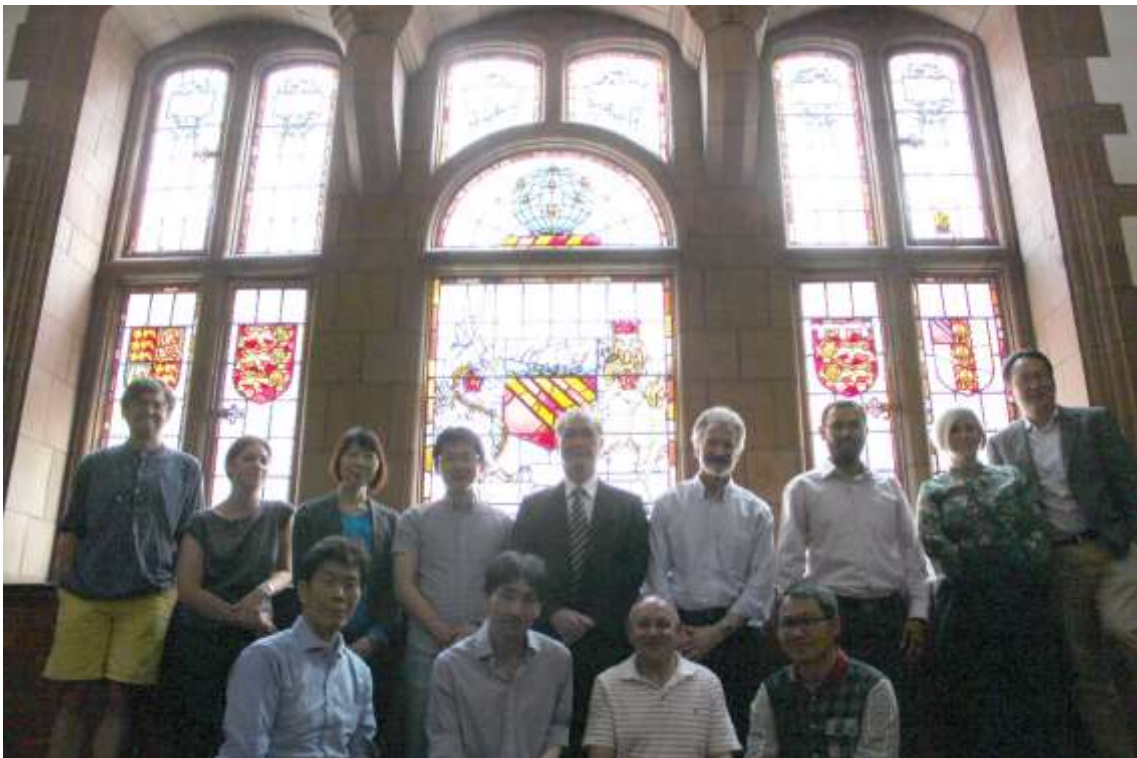
Research activities at the host institution, the University of Manchester, UK are focused on hyperspectral imaging and advanced digital processing to estimate the precise physical characteristics of natural scenes and then applying this information to study human colour-vision systems. Research in the MEXT SHITSUKAN project in Japan led by Dr Nishida (NTT Communication Science Laboratories) is highly relevant to these challenges. The project involves a wide range of research disciplines, such as human sensing, neurophysiology, and computational signal processing with their theoretical approaches verified by human psychophysics. Thus, the two research teams may share common research goals but take different approaches. Integration of these complementary lines of research will enable a more comprehensive and innovative approach to achieving our common scientific purpose: a better understanding of SHITSUKAN (perception of material quality) and the development of better colour rendering in digital production and advanced digital devices.

The symposium aimed to facilitate the transfer of knowledge and ideas between the participating institutions and to develop future research collaborations of benefit to both teams. An open discussion was arranged for all attendees to the symposium; then a formal discussion for the research collaboration between the Japanese and Manchester team was organized in a closed-meeting during which four invited speakers from Japan who are involved in the SHITSUKAN project introduced their state-of-the-art research.

The symposium was attended by researchers and students not only from the host institution, University of Manchester, but also other institutions, including the University of Leeds, University of Nottingham, Loughborough University, Manchester Metropolitan University, and Justus Liebig University Giessen, Germany.

The symposium was opened by Prof Ueno, the JSPS London Director. Research of skin colours in relation to SHITSUKAN were introduced by Dr Yoko Mizokami of Chiba University, the title of her talk was "Is perception of skin color and its SHITSUKAN special?", followed by a presentation from Dr Yu Fang of the Honda Research Institute Japan, entitled "Influence of facial colour distribution on perception of pigment spot". With consideration to Deep Learning applications, the recent advancements from a computational vision approach to SHITSUKAN were explained in the talk by Mr Hideki Tamura of the Toyohashi University of Technology, entitled "Distinguishing mirror from glass". Dr Shin'ya Nishida from the NTT Communication Science Labs was the final speaker from Japan and he presented an overview of the MEXT SHITSUKAN project with visual demonstrations. His presentation was entitled "Understanding human recognition of material properties for innovation in SHITSUKAN science and technology". From the host institution, Professor David Foster gave a talk entitled "Human colour vision and hyperspectral imaging" which focused on digital image processing and advanced imaging techniques as well as computational colour vision. The audience engaged with the speakers, showing their interest through an exchange of questions and discussion following each presentation. Finally, Mr Satomura, International Programme Associate of JSPS

London, introduced the JSPS activities and funding opportunities, including joint schemes with the UKRI and the Royal Society, which attracted the audience's attention.

The second day of the symposium was a closed meeting for the speakers and the hosts during which questions and feedback made at the time of the presentations were reviewed. After that potential research collaborations were discussed. These discussions ensured a more principled understanding of the SHITSUKAN in the natural environment will contribute to improved performance in various research topics in both engineering and sciences. For example, the SHITSUKAN of skin colours is closely related to the work under discussion with the EPSRC Doctoral Training Centre for Additive Manufacturing at the University of Nottingham, for which the University of Manchester has started a research collaboration through a prize from JSPS London. Further benefits will be in the development of digital sensing and display devices, also in signals and data transfer protocols and integration of Virtual Reality and Augmented Reality with implementation of 3D digital representations. Such collaborations could also contribute to establishing international standards for these advanced technologies by, for example, forming a CIE Technical Committee (Commission Internationale de l'Eclairage). Discussions also took place about the potential extensions to various research disciplines, including computer sciences, biology, psychology, medicine and health sciences, along with establishing academic training for postgraduate students. These developments cover a wide range of applications, including the development of assistive technology in clinical and medical research, which are currently priority research areas in the UK. **– Dr Kinjiro Amano, University of Manchester.**

Symposium Attendees