

## 10<sup>th</sup> Colour and Visual Computing Symposium 2020

This is the 10<sup>th</sup> time, that The Norwegian Colour and Visual Computing Laboratory at the Norwegian University of Science and Technology (NTNU) in Gjøvik, Norway has organised the Colour and Visual Computing Symposium 2020 (CVCS 2020), which this year has taken place on September 16-17, 2020. After careful consideration and in light of the global health emergency and pervasive travel restrictions, CVCS 2020 organizers have made the decision to conduct CVCS 2020 as a hybrid event in which the participants who had difficulties in joining physically at NTNU in Gjøvik could attend the conference virtually.

This edition of the symposium follows the success achieved by the previous events of the biannual Gjøvik Colour Imaging Symposium (GCIS), from 2003 to 2011, and Colour and Visual Computing Symposium (CVCS) 2013, CVCS 2015 and CVCS 2018.

The symposium has attracted a growing number of participants and provided a platform for fruitful discussion and exploration of recent theoretical advances and emerging practical applications in the field of colour and visual information processing.

During the past three CVCS events, the accepted papers were published as an IEEE proceeding. However, the papers accepted at CVCS 2020 are submitted for publishing as a CEUR Workshop Proceedings volume. This proceeding volume is published electronically with a gold open access, and is currently indexed by Google Scholar, DBLP, and Scopus.

The CVCS 2020 symposium contains a rich program of invited keynotes, together with regular talks contributed by young researchers and well-known international experts in the field. The papers contained in this Proceedings cover a wide range of topics including color imaging, appearance, vision, spectral imaging, visual computing, and medical imaging.

The CVCS 2020 Program Committee received 33 submissions. All papers went through a blind review process and each paper has been reviewed by three reviewers. The paper selection criteria were methodology used and scientific quality in terms of novelty and originality. Finally, 15 high-quality papers of high-quality scientific content were selected and presented at the symposium. In addition, one invited paper by Professor Azeddine Beghdadi, “On Measures of Visual Contrast and Their Use in Image Processing”, which the scientific committee saw fit for CVCS 2020 was presented.

Three keynote speakers contributed to the success of the event: Dr. Abhijeet Ghosh, (Imperial College London; Faculty of Engineering, Department of Computing, London, UK), Professor Edoardo Provenzi (University of Bordeaux; Institute of mathematics, France), and Dr. Giorgio Trumpy (Department of Film Studies; University of Zurich, Switzerland).

### **Keynote: Dr. Abhijeet Ghosh**

Title: Practical Spectral Imaging for Realistic Appearance Modeling

This talk will provide an overview of some of the research we have been conducting in the Realistic Graphics and Imaging group at Imperial College London on spectral imaging for appearance modelling. The talk will span techniques focusing both on material and facial appearance capture and modelling. The talk will first present our work on practical imaging of surface diffraction to model the complex iridescence seen on manufactured materials such LCD screens and holographic samples, and cover both practical spectral and polarization imaging techniques for modeling homogeneous as well as spatially varying surface diffraction. The second part of the talk will then focus on high quality facial capture with a multi-spectral Light Stage apparatus. Here, the talk will first cover our work on efficient facial reflectance separation using binary spherical gradient illumination, as well as further color multiplexing of illumination for a two-shot capture of facial reflectance and photometric normals. The talk will

conclude with our latest work on practical measurement and reconstruction of spectral skin reflectance for achieving photo-realistic rendering of a face driven by a bio-physically based spectral BSSRDF. Here, we will present optimal spectral measurements suitable for facial capture and estimation of detailed spatially varying skin chromophore concentrations for reconstructing spectral skin appearance.

**Keynote: Professor Edoardo Provenzi**

Title: Towards a Relativistic Quantum Theory for Color Perception

The presentation will deal with a modern program of refoundation of the theory of color perception headed by Michel Berthier et Edoardo Provenzi. This theory is based on the classical Schrödinger's axioms of color perception fused with the remarkable, but strongly underestimated, works of H. Yilmaz (1962) and H.L. Resnikoff (1974). It will be shown that Yilmaz's ideas recast color perception into a (special) relativistic framework, while Resnikoff's one leads to a quantum-like setting for color perception; together, they imply that a relativistic quantum model is necessary to understand how the human visual system senses colors. Mathematically speaking, the key to understanding how to deal with this framework is represented by the so-called Jordan algebras, which are commutative, but not associative, algebras used as an alternative for quantization with respect to the classical procedure based on the associative, but not commutative, algebra of self-adjoint operators over a Hilbert space. It will be shown how the properties of Jordan algebras turn out to match exactly with Resnikoff's results and to allow us integrating Yilmaz's findings in a single, coherent, framework. As a major result of this model, it will be discussed how the achromatic plus opponent codification of color is naturally contained in this theory, without the need of resorting to a-posteriori statistical analysis.

**Keynote: Dr. Giorgio Trumpy**

Title: Designing Spectral Imaging Methodologies for Works of Art

Imaging Science's major purpose is to render visible specific features by developing an effective interaction between the "tools of the trade" (radiation sources, optical elements, sensors) and the object that is analyzed. To obtain this effective interaction, a deep understanding of the physical phenomena involved and a dose of creativity are required. Among the Imaging Science's wide range of applications (medical, environmental, forensic, etc.) is Cultural Heritage. This is a particular challenging sector, due to the inestimable value of certain artworks and the contrasts that can arise between different interpretations of restoration ethics. A selection of case studies from internationally renowned collections is presented. The selection highlights particularly challenging analyses that required a change of perspective and offered new interpretations. Focusing on paintings, photography and motion picture film, several subjects are discussed: optical detection of dust and scratches on photographic film, virtual cleaning of paintings with discolored varnish, UV-VIS-NIR micro-spectrophotometry for the analysis of dispersed pigment particles, virtual rejuvenation of paintings with degraded pigments, film aesthetics and its rendition with digital cinema, the jarring contrast "strict conservators", who strive to protect the artwork integrity before anything else, and "technology enthusiasts", who appreciate the benefits of "enhanced" representations of historical films.

The preparation of these proceedings would not be possible without the assistance of many colleagues. Thank you to the members of the program committee:

Jean-Baptiste Thomas	Program chair
Giuseppe Claudio Guarnera	Program chair
Seyed Ali Amirshahi	Publication chair
Vlado Kitanovski	Publication chair
Jon Yngve Hardeberg	Publicity and sponsorship chair
Faouzi Alaya Cheikh	Special session and event chair

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Colour and Visual Computing Symposium 2020  
General Chairs: Peter Nussbaum and Sony George