

CHANGE

CULTURAL HERITAGE ANALYSIS
FOR NEW GENERATIONS

Newsletter - January 2022



January 2022 edition



Who knows what 2022 will bring, but it will certainly bring CHANGE news! In this edition of our newsletter you can read more about the activities and research of our CHANGE group before we entered the new year.

In November 2021, all CHANGE PhD fellows visited our project partners in Poland for the CHANGE School Poland and below you can read about their experience. Further down you can learn more about Yoko Arteaga's research on appearance of gilding on Cultural Heritage objects.

Enjoy!



Photos: Hands-on training at the Academy of Fine Arts, Warsaw

CHANGE School Poland

Home office. Lectures, presentations, meetings – all online. They had all been through it, numerous hours of theoretical content presented through a screen, with few breaks and limited social interaction. Now, the agenda was full of activities we *used* to describe as normal, like interacting with people *and* read their body language at the same time. It was set for a new CHANGE School – this time in person enabling practical work with tangible objects!

The destination was Warsaw, Poland, the city where three of the CHANGE partners are located. The organisers, led by Professor Robert Sitnik at Warsaw University of Technology (WUT), had prepared an interesting programme, balancing the imaging and conservation aspects of the CHANGE research in an excellent way. - *"Both imaging and conservation topics were covered in a way that actively involved us, making the learning process fun"*, says ESR 13 Alessandra Marrocchesi about the interactive sessions of the training school.



Photo: ESR 13 Alessandra Marrocchesi

The first two days of the Poland School were spent at the Faculty of Mechatronics, WUT, introducing the ESRs to the more technical part of the programme, namely 2D/3D/4D Multimodal Data Acquisition. ESR 8 Ramamoorthy Luxman highlighted the hands-on tutorial on the cutting-edge instrumentation for multimodal data acquisition and processing, saying it was useful in getting insights into the technology.



Photo: ESR 8 Ramamoorthy Luxman

- *"I had an opportunity to use and contemplate systems like computed tomography, white light interferometry and structured light 3D scanner which for me was inspiring and helped me widen my notion for my current research"*, he says referring to his research on Reflectance Transformation Imaging (RTI).

The first two days of training on imaging technology were followed by an introduction to conservation and restoration methods with Professor Jacek Martusewicz at the Academy of Fine Arts. This was a new experience for several ESRs. - *"It was the first time I attended a hands-on class in a conservation lab, and it was very fascinating to directly experience the different techniques introduced to us"*, Alessandra says. Ramamoorthy agrees, - *"the training offered a really rare opportunity for me to get introduced to the restoration of decorative ceramics and structures of woven textiles, cyanotype photographs, and the physics behind it"*. These insights were useful, providing the ESRs with a broader understanding of the field, placing their individual research in a wider context allowing new ideas for possible applications of their projects to grow.

The last part of the school was set to the picturesque venue of King Jan III's Palace at Wilanów where Eryk Bunsch guided them through their Laboratory for 3D Documentation, teaching the ESRs about their need to create digital documentation of cultural heritage objects.

Overall, both Alessandra and Ramamoorthy were satisfied with the training experience and felt it was incredibly useful and truly inspirational. It kept them engaged from morning to evening with several technical as well as social activities.



Photo: The CHANGE group outside King Jan III's Palace at Wilanów

Disseminating CHANGE in Trondheim

Learning from and discuss with actors from the Cultural Heritage Sector is of great importance for the CHANGE group. Recently, some CHANGE PhD students visited Trondheim in Norway to present the CHANGE project as well as their individual PhD projects. They also visited the Nidaros Cathedral restoration lab and the labs of the NTNU University Museum to learn more about their work and challenges.

[Read more here](#)



Photo: Visiting the Nidaros Cathedral in Trondheim

All that glitters is not gold, or is it?



*Photo: Painting with gilding.
(c) INP/Angèle Dequier*

Gilding is a form of polychromy in which a very thin sheet of gold is placed on top of a surface and attached using different methods. It creates the visual effect that the surface is indeed made of gold. This was extremely common in the Middle Ages, and it is one of the most important components of medieval polychromy. However, it has been used throughout millennia and all around the globe. Some examples of polychromy are Egyptian sarcophagi or altarpieces in gothic churches. The appearance of gold was meant to symbolise the wealth of a person and the magnificence and splendour of the "House of God".

Many paintings and religious icons are also gilded. However, due to exposure to the elements, bad storage and conservation conditions, and ageing in general, the original appearance of the gilded surface is lost. For this reason, it is important to study the appearance of gilding and how its appearance changes due to different conservation and restoration procedures.

Early-Stage Researcher (ESR) 7, Yoko Arteaga, is working on characterising the appearance of gilding to guide conservators' restoration treatments. In collaboration with the National Institute of Cultural Heritage (INP) in Paris, she is working with a conservation student who has made different gilding mock-ups replicating techniques from the Middle Ages.

Object appearance

The appearance of an object is linked to three main factors: its shape, the material it is made from and illumination it is under. All these three components are then perceived by an observer as the appearance of said object. Moreover, the appearance of an object can be described by its colour, translucency, gloss, and texture. Devices such as cameras or spectrophotometers can record aspects of appearance however, there is no machine capable of capturing an object's global appearance on its own.



Photo: Yoko preparing the mock-ups

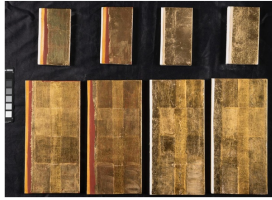


Photo: Gilded mock-ups

Light absorbing pigments on diffuse materials such as paper can be easily described using single geometry measurements which have a good correlation to their perceived appearance. However, glossy materials with high specular reflection, such as gilding, are more complex and their appearance varies when looked at and illuminated from different angles.

An important way to describe how an object looks from a given angle of observation at different illumination conditions is its Bi-directional Reflectance Distribution Function (BRDF). This function is widely used when rendering the colour and gloss of materials. It is specific to an objects' surface properties and takes as an input the angle of observation and angle of illumination and returns as output the colour of the object under these conditions.

Reflectance measurements instruments consist of a light source to uniformly illuminate the object and a detector such as a camera or sensor to measure the amount of light reflected. To obtain very accurate measurements of the BRDF, gonio-spectrophotometers are used. However, these are very costly, slow, and mainly available in research institutions or dedicated metrology laboratories. Thus, there is a real need, specially in the cultural heritage field, to develop more accessible methods and devices which can be used in museums, restoration workshops or archiving facilities.

Goniometric reflectance measurements

As part of her PhD thesis, Yoko has been working on developing such a technique which can provide information about the appearance of an object's surface when viewed and illuminated from different directions in a simple way and using widely available equipment. Using just a DSLR camera, a light source and a tilting platform, the sparkle effect of bronze patinas was characterised. This work has been presented in the 29th Colour and Imaging Conference and [the paper has been published in the conference proceedings](#).

A simple DSLR camera and a light source such as a flash are positioned at fixed positions making a 45-degree angle between them. The sample is placed on a tilting platform and at each angle of tilting a picture of the sample is taken. Then the images are processed to obtain information of how the reflectance of the surface changes as it is illuminated and viewed from different directions.

The samples' surface topography was also characterised using a white-light profilometer. This gives a 3D map of the peaks and valleys present in the surface structure at a microscopic scale and helps characterising the appearance of the objects. Smooth surfaces with a low roughness present high specular reflection, making them glossier, whereas rougher surfaces with many micro-facets oriented at different directions give a diffuse reflection and matt appearance.

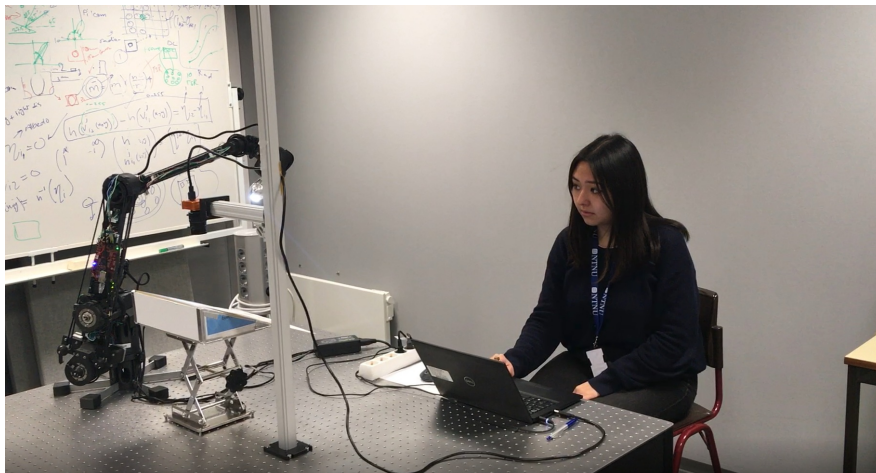


Photo: Yoko working with the robotic arm

Secondment work

Yoko has recently completed a three-months secondment at NTNU where she has worked on acquiring appearance measurements of gilding samples using different techniques. More specifically, she has been using an image-based set-up with an automated illumination thanks to a robot arm. This allows the light to be incident on the surface from almost any direction and the reflection is captured by a camera. With this information, the BRDF of the surface can be estimated. She hopes that these results will complement and validate the results from her own work.

She has also expanded the range of gilding samples to study, as she has gained access to mock-ups fabricated imitating a traditional method of "imitation" gilding commonly found in medieval sculptures from Northern Europe. This gilding is not made with gold leaves, but instead, a silver sheet is attached to the surface and a yellow resin is applied on top, giving the striking appearance of gold. This investigation in the appearance of different types of gilding can help conservators further understand the interesting appearance properties of these materials.

[Read Yoko's paper here](#)

[Find all CHANGE publications here](#)



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