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SURFACE ROUGHNESS AND THE APPEARANCE OF OBJECTS IN CULTURAL HERITAGE

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The appearance and perception of objects of art and cultural heritage is essentially subjective in nature. Among other factors, it depends on the viewer's state of mind in the broadest sense of the word, the person's background, and the environment in which he or she is observing the object. However, a viewer's perception of an object is triggered by the physical interaction of light with the object and its arrival at the viewer's eye. The interaction of light with the object is determined by the surface and near-surface properties of that object. The absorption and reflectance properties of the surface, combined with the lighting conditions, determine the what enters the viewer eyes.

On the technical side, much research has been conducted in the optics and related industries into how objects appear, how they are perceived, and how they can be realistically reproduced (rendered). Many of the research methods and results have been applied in the cultural heritage world, such as in traditional studies of pigments and dyes in paintings and polychrome objects, studies and theoretically modeling of the effects of varnishes and other coatings on object appearance, and more recently, "true colour" documentation and reproduction objects.

While colour perception is an important aspect in the appearance of objects, the surface roughness of objects plays an equally important role in how light interacts with objects. This goes beyond the simple determination of whether an object is glossy or matte. Information about roughness has already been theoretically considered in scattering models describing the effects of varnishes. [e.g. 1-2] However, restoration treatments, in particular cleaning, can cause significant changes to the roughness of objects, altering their appearance from what originally was intended. Further, roughness is an important parameter in light scattering models used to "realistically" reproduce (render) objects. It is thus rather surprising that little experimental work has been done to actually incorporate real roughness data into such models, or to perform simple measurements to determine the effect of treatments on the surface roughness and appearance of objects.

Equipment for measuring roughness has been commercially available for decades, developed initially for use in the science of tribology, the study of friction, wear, and lubrication of materials. Such equipment is now commonly used in many industries for quality control, not only for tribological applications, but, in fact, to guarantee the consistent appearance of products.

Several years ago, the Netherlands Institute for Cultural Heritage (ICN) began using rough-ness measurements, profilometry, for studying surface changes in paintings, and for the rendering of objects.[3-6] Non-contact confocal white-light profilometry is used to allow investigators to directly study the objects themselves. It provides high resolution, quantitative data with the spatial resolution of a light microscope, under 1 µm, and depth (roughness) resolutions down to the nanometer range. The application of this technique has since been expanded in the European FING-ART-PRINT to its use in "fingerprinting" objects for tracking and tracing, and protection against theft and illegal trafficking. The purpose of this communication is to review the concept of (micro) roughness measurements, and their possible applications in the conservation of cultural heritage.

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