Efficient technique for characterization of visual properties of surfaces

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This contribution presents technique utilizing portable scanner and custom-written image processing software for characterization of visual properties of cultural heritage objects' surfaces. The project involving development of this technique is supported by Czech ministry of culture.

Objects of cultural heritage communicate their historical and esthetical values to visitors mostly visually. This is due to the fact that thin surface layer, especially in sculptures and decorations, represents the most sophisticated and concentrated manifestation of craftsmanship of its originator. Therefore the surface preservation is the crucial task in conservation and restoration practice. Limiting the frequency of interventions has to be optimized in order to achieve balance between controlling surface alterations caused by various unwanted processes and the risk of partial loss of the surface's material due to intervention. The best way to accomplish such a task is regular monitoring of surface evolution and planning for intervention prior serious damage can occur. The monitoring is performed as periodic inspections involving measurements of the visual properties of the same area. This obvious arrangement is accompanied with some difficulties which the presented technique is capable to overcome. For example, as permanent installation of monitoring device is forbidden because it impedes historical object's esthetics, it can be placed only temporarily during measurement and then has to be removed. The measuring device's reinstallation raises the question on its spatial repeatability, i.e. whether the states of the same area are compared in the course of time. This serious issue can be overcome in two ways – the strict device placement repeatability has to be provided, or the robust method for evaluation of visual properties has to be adopted. The second approach is shown in this contribution – the elaborated technique is based on evaluation and statistically supported analysis of a finite area in contrary to point-wise approach implied by use of other devices, e.g. spectrometers. Advantages of this technique are clear: if the whole area is evaluated at once, error due to minor shift is statistically suppressed. Also selected area would be representative for the whole object more likely than set of points. This technique also can maintain balance between the requirements of repeatability and sensitivity of measurement on one hand and the innate variation of visual properties of studied surface, e.g. of natural stone, on the other.

The measurement procedure of the presented technique is quite simple: portable flat-bed scanner is placed over the region of interest and image of surface is acquired. Than the image is processed by custom-written application implementing statistical evaluation of the image data. Processes like crust formation from patina, efficiency of surface cleaning procedure, salt efflorescence and color change due to heat treatment can be depicted veritably this way. This capacity to describe such processes relies on selection of suitable "color space" of image. It was found that RGB (red, green, blue) components rather obscure important phenomena and wiser choice is the use of HSB (hue, saturation, brightness) coordinates that enable illustrative characterization of changes in specialized diagrams and also time-series plots. Once these plots are created in the course of data processing, only thresholds have to be defined to set-up monitoring, which is demonstrated in results section of the presentation.

It can be concluded, that due to negligible investments into hardware, availability of robust software, this technique can be effortlessly adopted and used by conservators, restorers and other interested practitioners for field documentation and monitoring of surfaces.