Towards a *distant viewing* of depicted materials in medieval paintings

Nicka, Isabella
isabella.nicka@plus.ac.at
University of Salzburg, Austria

Uhl, Andreas
andreas.uhl@plus.ac.at
University of Salzburg, Austria

Landkammer, Miriam
miriam.landkammer@plus.ac.at
University of Salzburg, Austria

Linortner, Michael
mlinortner@cs.sbg.ac.at
University of Salzburg, Austria

Schuiki, Johannes
jschuiki@cs.sbg.ac.at
University of Salzburg, Austria

How are materials (e.g. wood or stone) depicted in medieval visual media, what role do representations of texture or surface quality play in communicating with beholders, and what further conclusions can be drawn about this artistic period by their exploration? Identifying patterns or outliers concerning the imitation of materials in medieval paintings has up to now been possible only on a very small scale, as relevant digital metadata are rarely available for an application of DH methods and a distant viewing approach (cf. Arnold / Tilton 2019, Klinke 2020, Nicka 2019: 100–119). Establishing the importance of such DH-analyses, as well as collaborating with computer vision to be able to (semi-)automatically recognize and compare depicted surface textures, their positions and proportions in medieval visual media in the future are therefore the main objectives of the KIKI-project (*Wie das Material ins Bild kam: Kulturelle Innovationen interdisziplinär mit künstlicher Intelligenz erforschen*), funded by the federal state Salzburg.

Computer vision methods have been applied with different objectives in the field of art historical or preservation-related analysis of paintings, ranging i.a. from artist or style classification to object detection, and the detection of human poses (Cetinic 2021). Also the recognition of materials used in the production of paintings has been addressed (Kleynhans et al. 2020). In contrast, the project KIKI develops and tests deep learning-based techniques for the recognition of materials represented with painterly means. The adaption of an object-recognition CNN targeted for natural scenes for detecting material depictions in paintings has been occasionally examined (Lin et al. 2021), however main emphasis was given towards exploiting the training on paintings to improve CNNs used on natural images. This project explores the use of AI-based material recognition to allow for comparison of the imitation of surface textures across large corpora of artworks in the future. For material characterisation, we will particularly focus on deep learning-based texture classification techniques [Aggarwal 2021], as proposed for classical CV-related texture datasets and adapt those for material detection, and as well adapt semantic segmentation techniques [Castellano 2021] (see for an example a survey of domain-specific semantic segmentation techniques [Yuan 2021]) to determine the exact shape of the respective objects. In order to limit annotation cost across different painting styles, we will formulate the transition among painting styles as domain adaptation, to be able to exploit material labels across painting styles.

The perspective of Materialikonologie – the inquiry into the role that the physical materials of the artwork play in its meaning – has been central to the study of medieval art since the late 1960s (Bandmann 1969, Raff 1994, Reudenbach 2002). Much less attention has been directed to materials evoked, imitated or fictionalised within pictures, such as rock (Rachman-Schrire 2019, Kim 2019), marble (Mestemacher 2021, Dunlop 2016, Didi-Huberman 1995), coral (Saß 2012) or skin and (semi-)transparent materials (Lehmann 2016, Bol / Lehmann 2012). These studies have carved out, amongst other things, interdependences between depicted materials and painting materials/processes, pictorial references to pre-modern natural philosophy or religious materialist allegoresis, relations to the contemporary availability or valuing of certain materials. They thus have shown the analytical potential of depicted materials for our understanding of medieval visual works of art.

In KIKI, alongside the focus on AI-based material recognition techniques, a dataset on 14th- and 15th-century painting with existing relevant high-level annotations from the REALonline image database is used for exploratory art historical analyses on depicted materials. These manually generated annotations are modelled as scene graphs (cf. Matschinegg et al. 2019) and depicted materials are recorded as properties of object nodes, thus creating robust data for queries related to iconographic subjects, further depicted entities etc.

In our presentation, we will focus on the one hand on the interim results of these exploratory analyses, showing how visualisations based on the REALonline data aid in detecting and documenting clusters of specific use of materials in images. On the other hand, by exploring in depth material representations in specific contexts, we have found that more specific labeling categories are needed in order to compare textures like various wood grains, that can serve specific functions in the pictorial narrative. These multiple categories also affect the requirements on annotation tools as the metadata is much richer as compared to classical CV-oriented annotations, and we will demonstrate how traditional annotation software is used to meet those requirements. With respect to first results, we will show outcomes of wood-related retrieval attempts using real-world wood photographs to retrieve depicted wood in our target images.

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