GENERALIZING TO UNSEEN PAINTINGS WHEN CLASSIFYING 14TH-CENTURY PUNCH MARKS

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Punch marks are decorative impressions created by hammering a tool with a pattern on one end into gold ground paintings. Intricate punch marks started becoming widespread during the 14th and 15th centuries in Italy. The tools to create punch marks were often used in multiple paintings and were sometimes shared with other workshops, making punch mark classification useful in various art-historical investigations. While standard convolutional neural networks have shown the capacity to excel at automatically classifying punch marks, they can become substantially less accurate when tested on images of punch marks from panels unseen in the training data [1].

Framing the problem as one of domain generalization, we evaluate several methods on their ability to classify punch marks from panels not in the training data. We use images from [1] alongside photographs and microscopy images from 14th-century panels by Simone Martini currently at the Fitzwilliam Museum, University of Cambridge, and at the Wallraf-Rischartz Museum in Cologne, Germany. In this context, we find that domain generalization methods can yield remarkable improvements in accuracy for unseen panels, potentially achieving accuracies above 70% where other standard convolutional neural networks do not exceed 40%. These results illustrate the importance of domain generalization in this setting and suggest the potential to aid art historians and conservators in classifying punch marks.

References

[1] M. Zullich et al., *An Artificial Intelligence System for Automatic Recognition of Punches in Fourteenth-Century Panel Painting*, IEEE Access, 2023, pp. 5864–5883.