A Visualization Tool for Image Fusion of Artworks

Image Registration and Visualization of Image Overlays for Motifs in Historical Prints

Aline SINDEL[1,2], Andreas MAIER[1], Vincent CHRISTLEIN[1]
[1]Pattern Recognition Lab, FAU Erlangen-Nürnberg, Germany
[2]Germanisches Nationalmuseum, Nuremberg, Germany

Keywords: *Visualization Tool — Image Registration — Artworks — Prints*

CHNT Reference: Aline Sindel, Andreas Maier, and Vincent Christlein. 2020. A Visualization Tool for Image Fusion of Artworks. Proceedings of the 25th International Conference on Cultural Heritage and New Technologies.

Introduction

Quite a number of portraits of Martin Luther – known as media star of the 16th century – can be found in today's museums and libraries. In particular, there is a large number of prints (copperplate engravings and woodcuts) of the same or similar motifs. Which of these prints actually originate from the same printing plate or block? For the comparison of the high number of images, automatic processes are necessary to align the prints.
Hence, in this work modern computer vision techniques are utilized to automatically register the prints to a reference image of the same motif. Further, a visualization tool is designed that allows the visual pairwise comparison of arbitrary artworks that have been registered to the same reference image. The visualization tool is developed to support art historians in their daily work by providing different visualizations of image overlays that can facilitate the detection of fine differences between two artworks.

Methodology

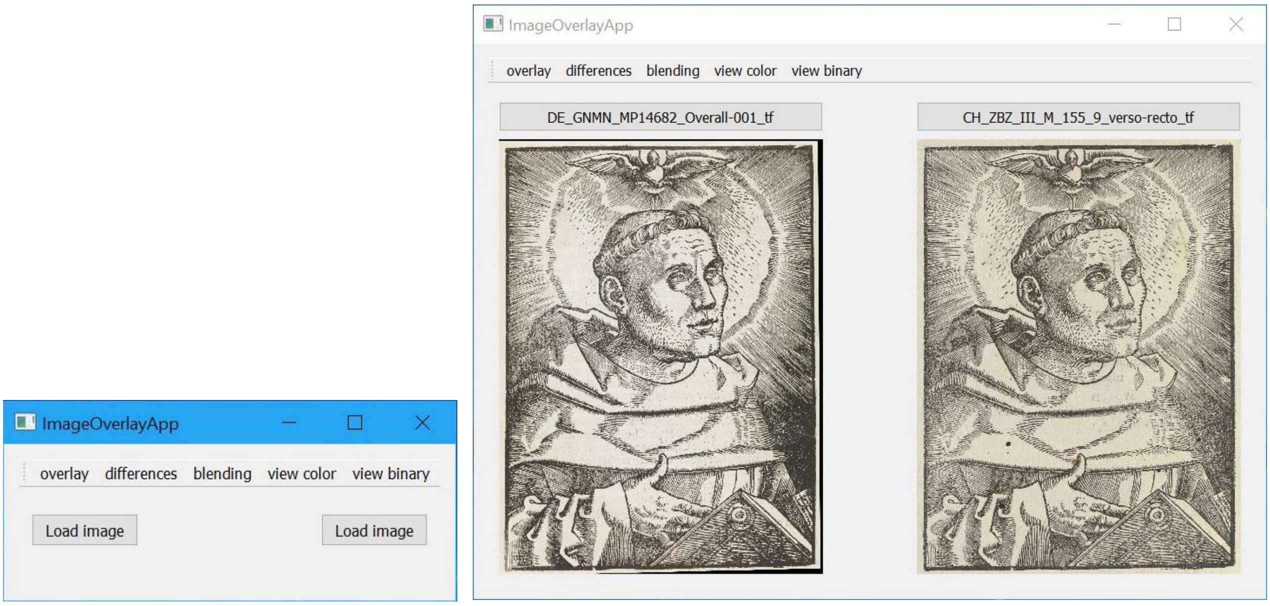
Registration of Motifs in Historical Prints

Image registration methods have been extensively explored in literature and can be classified into intensity and feature-based methods. Intensity-based methods find similar patterns based on correlation metrics, while feature-based methods detect point correspondences in both images to estimate a rigid or non-rigid transformation. Early feature-based methods use handcrafted features such as SIFT by Lowe (2004). Learning based methods use machine learning to replace the keypoint detection, descriptor learning or matching step or design end-to-end networks.

In this paper, SuperPoint by Tone et al. (2018) is used for the registration task of prints. SuperPoint is a self-supervised deep learning method that learns to detect homography consistent keypoints. Due to the high image resolution of the prints, the images are split into patches of size 1024×1024 and are fed to the SuperPoint network. Uni-directional brute force matching is used to match the keypoints from both images. The matches are filtered with the ratio test by Lowe (2004), a spatial distance thresholding and by removal of ambiguous matches. Then, RANSAC by Fischler and Bolles (1981) is used to estimate a perspective transform.

Visualization of Image Overlays

The graphical user interface of the visualization tool designed for this work is shown in Fig. 1a. Two images can be selected by drag and drop or by using the file opener and are then depicted in the main window, see Fig. 1b.



a *b*

Fig. 1. Graphical user interface of Image Overlay App: a) Menu to select images, b) Images loaded. Images: Martin Luther, Hans Baldung, Germanisches Nationalmuseum, Nuremberg, MP14682 and Zentralbibliothek Zürich, III M 155,9.

The visualization tool provides three different options to visualize the image overlay that are summarized in Fig. 2. The false-color overlay expressed in red-cyan colors, see Fig. 2a, stacks one of the two images into the red channel and the other image into both, the blue and green channel. Higher black levels of the first image will be expressed in cyan and of the second image in red. In Fig. 2b the difference image is depicted which is computed by first converting the images to gray-scale, then subtracting the images from each other, normalizing the difference image to $[-1, 1]$ and applying the Jet colormap. For the areas depicted in light green the difference is zero, while a bluish or reddish color indicates a higher black level of either the first or the second image. There is also the possibility of applying alpha-blending between both images as illustrated in Fig. 2c,d. By moving the slider from left to right, the image linearly blends from the second image (Fig. 2c) to the first image (Fig. 2d).

Furthermore, both images in color or as binary images can be opened as separate windows to inspect the images next to each other in detail.

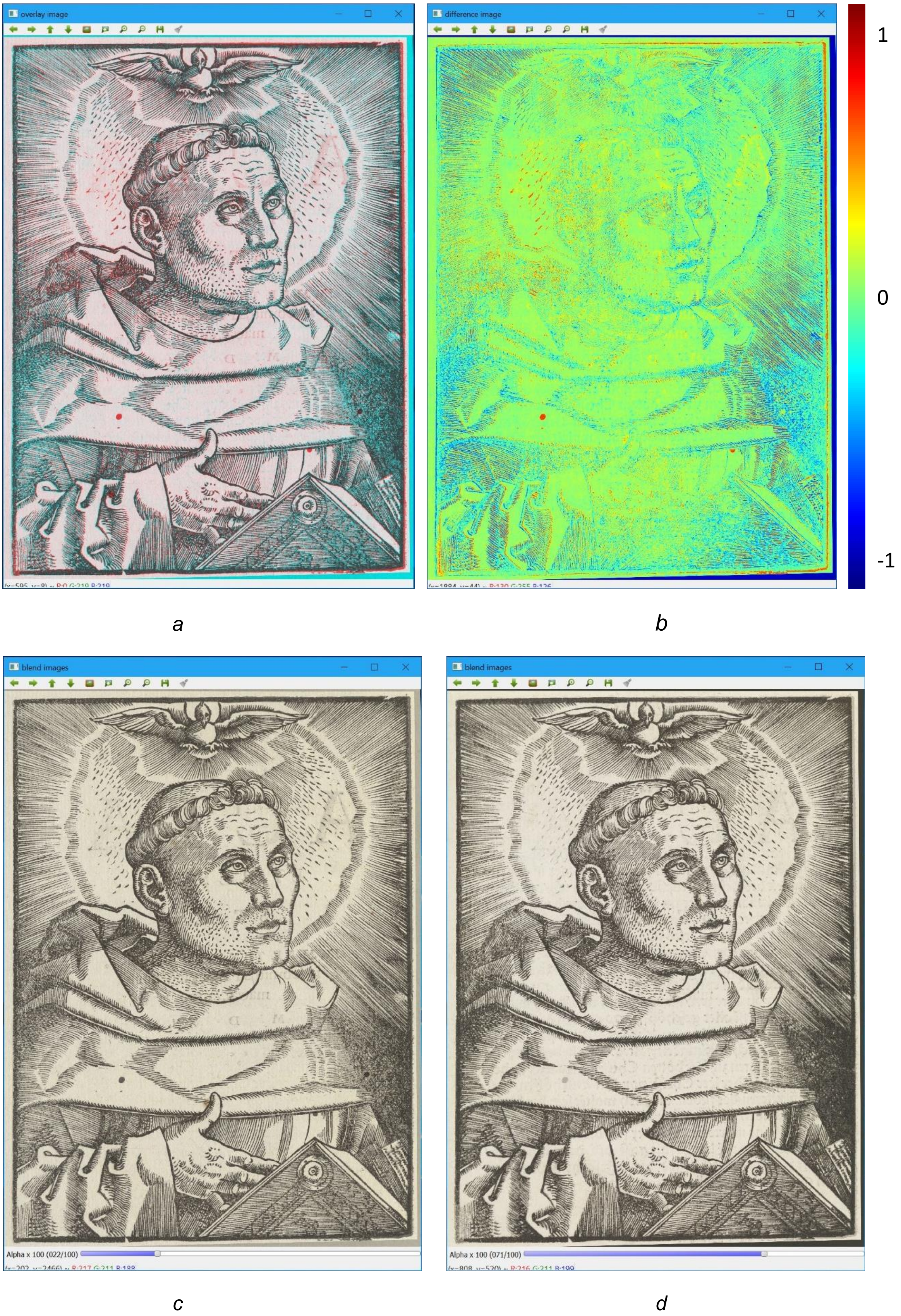


Fig. 2. Three different options for the visualization of the image overlay: a) False-color overlay, b) Difference image and alpha-blending from the second c) to the first image d).

Conclusion

The different visualizations of the image overlays can help the art historians to spot subtle differences in prints of the same motif which can give hints whether two prints belong to the same printing plate or block. The visualization tool can be used to compare arbitrary artwork pairs and is not only restricted to prints. The only prerequisite is that the images are registered to the same reference in order to allow a sensible comparison.

Acknowledgements

The image data was collected within the research project “Critical catalogue of Luther portraits (1519-1530)” which is a joint project of the Germanisches Nationalmuseum Nuremberg, FAU Erlangen-Nürnberg and TH Köln. The project received funding from the Leibniz Society (SAW-2018-GNM-3-KKLB).

References

DeTone, D. Malisiewicz, T. and Rabinovich, A. (2018). 'SuperPoint: Self-Supervised Interest Point Detection and Description', Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshops, pp. 224-236

Fischler, M. A. and Bolles, R. C. (1981). 'Random Sample Consensus: A Paradigm for Model Fitting with Applications to Image Analysis and Automated Cartography'. Communications of the ACM, 24(6):381–395

Lowe, D. G. (2004). 'Distinctive Image Features from Scale-Invariant Keypoints'. International Journal of Computer Vision, 60(2), pp. 91–110