Locating Transportation Damages by Digital Imaging: Two Case Studies

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Dedicated to Christian Wolters

Abstract

This contribution presents two art-in-transit case studies where surface texture changes on the paintings of E.-L. Kirchner and A. Sisley were successfully detected. The changes were identified using the VASARI system, which allows one to digitally image paintings in high resolution before and after transportation. Appropriate software tools were developed to detect microcracks, deformations, and losses, highlighted as differences between the before and after images. The evaluation principles are given. As a result of this study, a methodology to control art in transit has been developed, and indications have been obtained that the paintings have undergone changes sometime between the acquisition of the digital image(s) before and after transportation.

Keywords

Art in transit, transportation damages, paintings on canvas, digital imaging, image processing, VASARI system, E.-L. Kirchner, A. Sisley

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Introduction

Art in transit is a controversial area of conservation, and there are at least as many views and interests as there are professionals involved in the transportation process. Opinions range from not loaning any of the entrusted objects, to a general loaning restraint, and even finally to statements such as "Modern shipping techniques and equipment can now virtually guarantee a safe journey of artworks" (1).

Recent publications have addressed the optimisation of the transport event itself, the method of transportation (including the choice of the route and the type of packing), and the control of the environment in the packing case with special focus on vibrations, temperature and humidity (2). However, little attention has been give to the question: Is there any difference in the condition of the object before and after transportation? We think that this is the key question.

Surprisingly, not many have tackled this question and published results. Early papers by Wennberg and recent contributions by Baribeau *et al* describe attempts to image and compare the condition before and after a distinct event (3–6). Whereas Wennberg studied paintings in a real transportation situation by photography, Baribeau *et al* report an example of a painting that was placed on a vibrating table to simulate transportation stress in an worst case scenario. Their laser scanner allowed an accurate digital representation of the painting's surface. We recently were told that these representations are now superior to those published (7). Wennberg and Baribeau *et al* restricted themselves to pre-selected details of the paintings. In both cases, any comparison of images, e.g., the localisation of surface texture changes, is done by visual inspection.

Methodology

In a different approach presented here, we use recent information and technology from the field of digital imaging. We aim to represent the painting's surface in full size and with high resolution. The comparison of the images taken before and after transportation ("before" and "after" image) can be done independently from the human observer. Appropriate software tools indicate any change of the surface texture. The results are judged by visual inspection, using the unprocessed "before" and "after" images. If differences between the two images are found, they are noted as either a beginning of a change of the painting's surface texture, or as a damage. We define these damages as transportation damages (8). Surface texture changes and transportation damages not only happen during shipping, but also during in-house handling and moving, such as during hanging, (un)framing, photography, or (un)packing.

Our project at the Doerner-Institut drew benefit from the European research project VASARI (ESPRIT II No. 2649) that allowed us to set up a digital image acquisition and processing system. The system is described elsewhere in more detail (9). It combines an easel, a 3-D repositioning unit, a high resolution CCD camera, and a UNIX-based workstation. The latter controls the repositioning unit and provides the user with a wide range of digital image acquisition and processing tools that are handled with specially designed human-computer interfaces.

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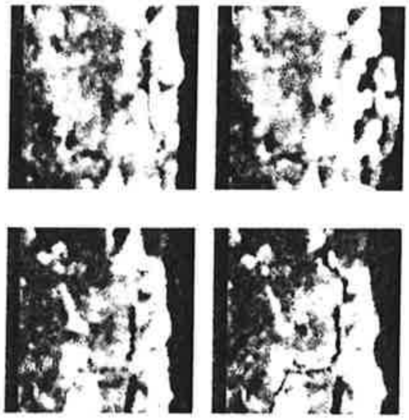
Our methodology to detect surface texture changes using the VASARI system, including the first applications, has been recently outlined in detail (10). In the present paper, two additional case studies are described.

Case Studies

The two case studies are paintings from our collection that went on loan to different exhibitions. Both passed the thorough, regular condition control procedure by the conservator responsible for the loan arrangements. The paintings were digitally imaged full size with the VASARI system ("before" image). This is done in black and white which was considered sufficient for our purpose. The spatial resolution is about 20 pixels/mm. During acquisition the environmental conditions are carefully controlled. Subsequently, each painting was handled, packed, and shipped as usual. After having returned from exhibition, a second image ("after" image) was taken under the same conditions as the "before" image.

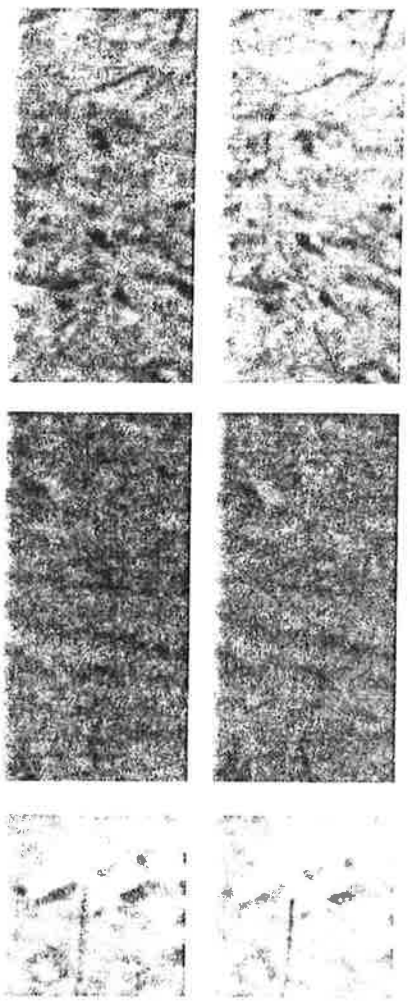


1 Kirchner, details of the "before" (left) and "after" (right) images. 1a) deformation and baking of the paint layers, and 1b) prolongation of (micro)cracks.

The two paintings were (1) E.-L. Kirchner, *Kartenspielender Knabe*, oil on canvas on stretcher, 69.3 × 62.3 cm (Bayerische Staatsgemaldesammlungen Munchen) and (2) A. Sisley, *La Route de Hampton Court*, oil on canvas on stretcher, 38.8 × 55.4 cm (Bayerische Staatsgemaldesammlungen Munchen). Each had been packed into an insulated case consisting of soft fibre board, polyethylene cushioning, aluminium-laminated polyurethane foam plates, and a plywood case. The Kirchner went by truck, and the Sisley travelled by truck and aircraft.

Evaluation procedure

A. Given the resolution, one single image covers an area of only about 10 × 13 cm. Therefore, a set of sub-images had to be taken by displacing the VASARI camera with the repositioning unit. For the Kirchner 5 × 8, and for the Sisley 5 × 4 sub-images (7 MB each) were acquired. The acquisition time for one sub-image is about 3 minutes. The painting is kept strictly static and is not disturbed during image acquisition. The resulting amount of data per acquisition, i.e., 280 MB for the Kirchner and 140 MB for the Sisley, cannot be easily handled. After acquisition, the data is therefore compressed and stored on tape. For subsequent image processing, the data must be read and uncompressed again. During image processing the amount of data can, at times, grow to 1 GB or more. To allow surveying the painting in full format on the monitor, the sub-images are shrunk to a manageable size. The shrunken sub-images are then merged to obtain a full representation of the painting (survey image). This survey image is the base for the protocol image to be introduced later under C.



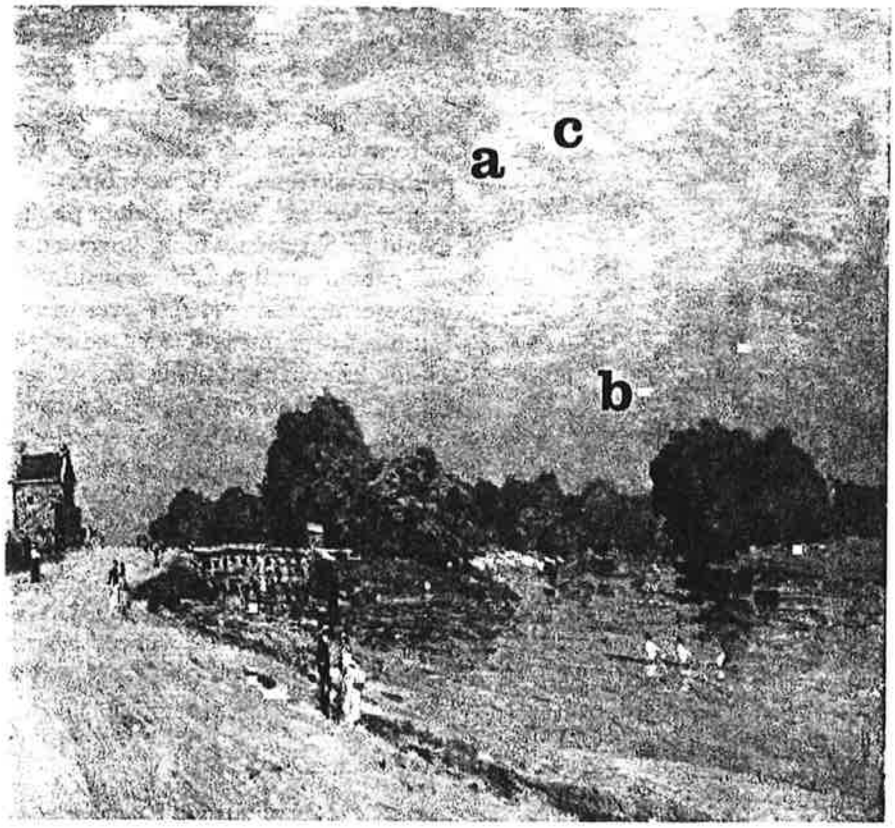
2 Sisley, details of the "before" (left) and "after" (right) images. 2a) top, 2b) middle, and 2c) bottom, widening and prolongation of cracks.

B. The next evaluation step is to search for differences between the "before" and "after" images. To do so, the uncompressed sub-images are processed to allow for an easy comparison. This processing includes resampling of the "after" images for later superposition with the "before" images and crack-detection algorithms that have been written for the specific painting. The main intention is not to substitute the human observer, but to indicate where changes of the surface texture may have happened. To enable a fast identification of the changes, regions with no changes are represented black or grey on the monitor, whereas actual changes are highlighted in colour. Finally, the resulting indicator image is used to conduct a thorough comparison of related details in the "before" and "after" sub-images. The Figures 1 and 2 show a set of indicator images juxtaposed with the related details on the "before" and "after" sub-images. To support the user, we are aiming for an automatic computer-generated summary of changes which will range from large to minor changes.

C. If the set of changes has been clearly identified, their location is given in a protocol image where (coloured) spots or characters are introduced into the survey image. The spots allows one to obtain a quick impression where differences are located. The characters in figure 3 actually relate to the regions on the Kirchner shown in figures 1a and 1b, those in figure 4 to figures 2a–c. Details from the high resolution sub-images also help to visually zoom into the area where differences have been found.

D. The images A to C—giving the location as well as a close-up of the differ-

3 E.-L. Kirchner (for more details about the painting see text), digital protocol image on the base of the survey image with indicated differences (squared spots), as well as the two changes a and b shown in figures 1a and 1b.



4 A. Sisley (for more details about the painting see text), digital protocol image on the base of the survey image with indicated differences (squared spots) and the three changes a, b and c shown in figures 2a, 2b, and 2c.

ences—are used during a discussion of the results while inspecting the actual painting itself. This final evaluation should be done most thoroughly, while bearing in mind that any result of image processing is dependent on the quality of the "before" and "after" images. Moreover, in our experience, the final agreement on a set of changes or transportation damages can only be confirmed while being in front of the painting. In practice, their identification is not always easy and therefore not quite definite even when using a microscope.

Results

In case of the Kirchner with its brittle and thin paint layers, most of the detected differences are located along the right and the top edges of the painting, whereas nearly no differences are found toward the centre. Because of a slight overexposure, all the images on the left and lower edge could not be properly processed and evaluated. In these areas, additional differences might be found when applying specially adapted image processing tools. As shown in figures 1a and 1b, flaking, deformations, and a prolongation of cracks on the right edge could be unambiguously proven.

On the other hand, for the Sisley, most differences are located in the centre of the painting, mainly in the sky. Typically, microcracks seem to be widened and/or prolonged whereas deformations or even losses could not be observed. The sensitivity of the procedure can be noticed from a single hair of about 3 mm length on the "before" image, which obviously has been dusted away before the "after" image was taken. This hair appeared as a coloured highlighted difference on the indicator image.

Conclusions

Compared to previously published work or the common practice of transportation condition control, the procedure proposed here is an obvious improvement. The VASARI approach, although still being a pilot project, allows the detection of transportation damages. Because the approach is not restricted to pre-selected details, an unprejudiced control of the full painting is possible (11). Being largely independent of the human eye, the condition control is more objective. All results can be related to actual changes and can be used to objectively prove surface texture changes and transportation damages. However, the technical development of the procedure is still ongoing.

For both paintings, the changes are basically restricted to micro-cracking or to deformations which may starting points for further damages (raking damages, blisters, and losses). Furthermore, using our approach, different kinds of changes can be detected. In our previous publication, losses along the edges of a painting could be observed which, however, were mainly caused because the painting, for experimental reasons, was shipped in a regular insulated case, but without a protecting frame (10). Nevertheless, even under regular transportation conditions, as for our two case studies, the surface texture of the Kirchner and the Sisley had changed. Thus far, we are not able to trace back these changes to any causes. However, the main purpose of this contribution–address the question if there are differences between the condition of the two paintings before and after transportation–can be answered affirmatively.

Acknowledgements

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References and Notes

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