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***eContentplus***

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<sup>1</sup> OJ L 79, 24.3.2005, p. 1.

## Scope of work in this deliverable

The scope of the work in this deliverable is to advance the capabilities for expertise of papers and watermarks using the reproductions of sieve imprints in paper. This expertise is divided into four areas:

1. Authentication – decide if two papers originated from the same mould;
2. identification – determine the date and production location;
3. measurement – measure sieve imprint features, such as watermark size, laid lines density, or chain lines distance (see extended list on [http://www.bernstein.oeaw.ac.at/twiki/pub/Main/ImageProcessing/atanasiu2005\\_-\\_Paper\\_Study\\_Toolbox\\_Overview.pdf](http://www.bernstein.oeaw.ac.at/twiki/pub/Main/ImageProcessing/atanasiu2005_-_Paper_Study_Toolbox_Overview.pdf));
4. methodology – evaluate existing expertise methods and develop new ones.

### Sieve feature measurements in binary images

Printed watermark catalogues are still an important tool for the identification of watermarks. One goal of Bernstein is to include this catalogues into the portal and to make concordances between online and printed data. Therefore, a software tool was developed which isolates watermarks from the Piccard Online Database and the printed Piccard collection. First of all, it automatically isolates a single watermark, then the user checks the outcome and corrects the errors. The final output shows only watermark information leaving aside metadata, chain and laid lines. These images are then used to measure further watermark features such as width or height. Currently, these isolation tools are being used by the Bernstein partners LABW in Stuttgart and OEAW in Vienna.

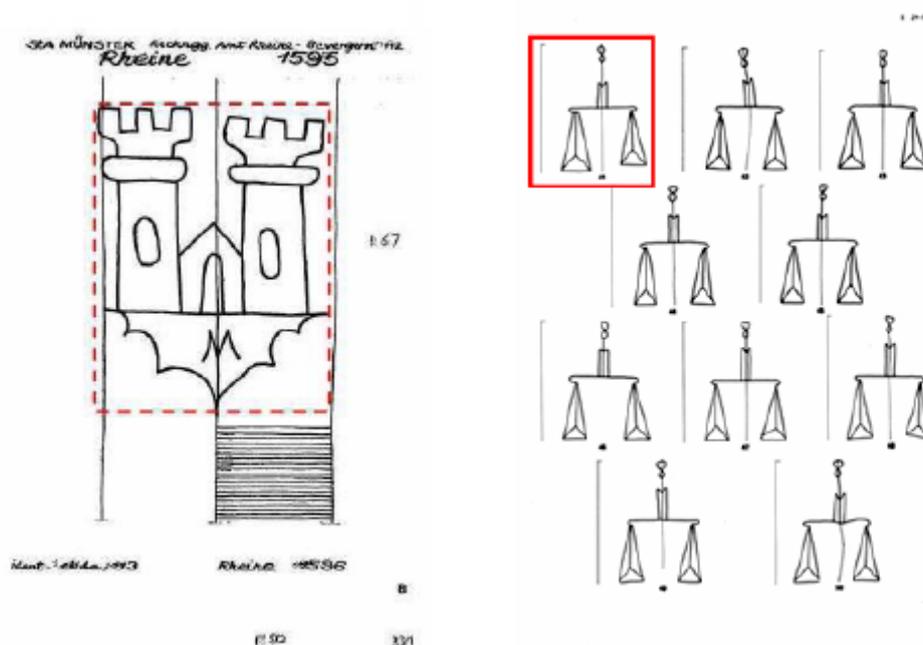


Figure 1: Isolation of watermarks in the printed Piccard catalogues

This software tool was presented in a paper (by Héctor Moreu Otal and Jan C. A. van der Lubbe) entitled *Isolation and Identification of Identical Watermarks within Large Databases* at EVA conference (International Conference on Electronic Imaging Visual Arts) Berlin, November 12<sup>th</sup>-14<sup>th</sup>, 2008.

The tool measures neither laid lines density nor chain line distance. The images contain only a few laid and a few chain lines drawn by hand therefore such measurements would be neither very reliable nor really useful.

### Sieve feature measurements and segmentation in grayscale images

This is a software tool that measures laid lines density and chain lines distance in X-ray and backlight images of pieces of paper. It also generates a binary image with the chain lines isolated. On the other hand, our software does not provide an image with the laid lines shown since such images would collect many noisy structures and it couldn't be used for research purposes.

This work was published in a paper (by Jan C. A. van der Lubbe, Pavel Paclik, Mark van Staalduin and Eric Backer) entitled [Paper retrieval based on specific paper features: Chain and laid lines](#) at the International Workshop on Multimedia Content Representation, Classification and Security, in September 2006.

### Software that automatically detects watermarks in X-ray and backlight images

These techniques were presented in a paper (by Héctor Moreu Otal, Mark van Staalduin, P. Paclik, Jan C. A. van der Lubbe) entitled *Watermark Detection in X-Ray Images from Paper for Dating Artworks at IASTED Innsbruck*, in February 2008.

### Watermark imaging by backlight subtraction

A software tool able to extract the paper structure by subtracting a transmitted image from a reflected image was developed. This tool is also useful for measuring the resolution of the original images as long as the reflected images show a ruler. Our software also removes the parts of the image containing paper information.

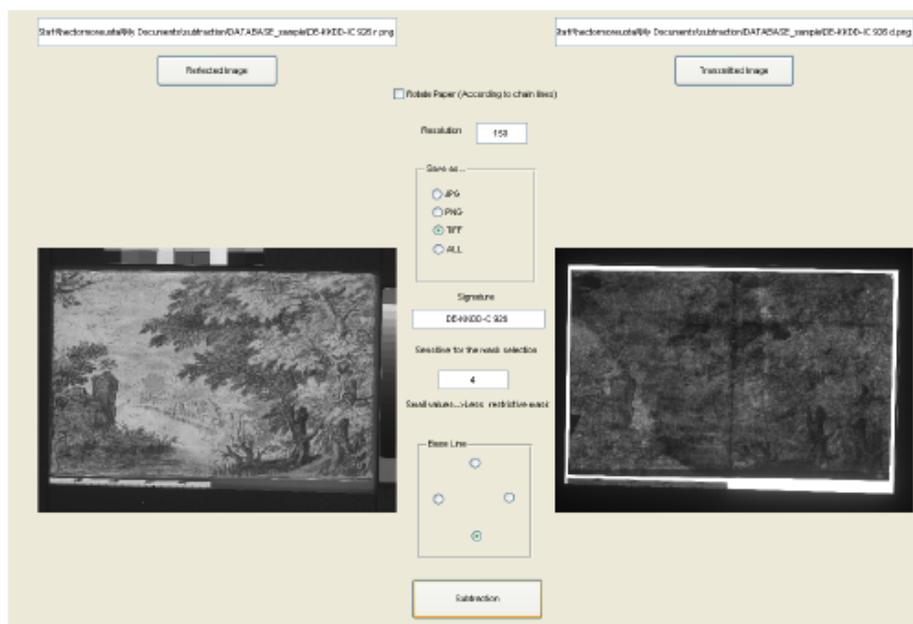
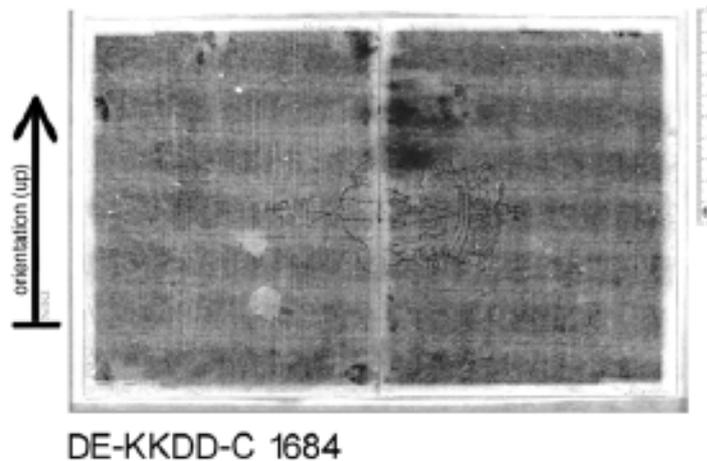


Figure 2: Backlight subtraction software



**Figure 3: Result of the backlight subtraction of the example shown in Figure 2.**

This method was published in a paper (by Mark van Staalduinen, Jan C. A. van der Lubbe, Georg Dietz, Frans and Theo Laurentius) entitled *Comparing X-ray and backlight imaging for paper structure visualization* at EVA Florence, in April 2006.

### **Paper identification**

This is a software tool for finding those watermarks in the printed Piccard collection that are not within the Piccard Online database. The first version is already available but we are waiting for more isolated watermarks from both collections. Currently, the isolation task is being carried out by our project partners in Stuttgart (LABW) and Vienna (KSBM).

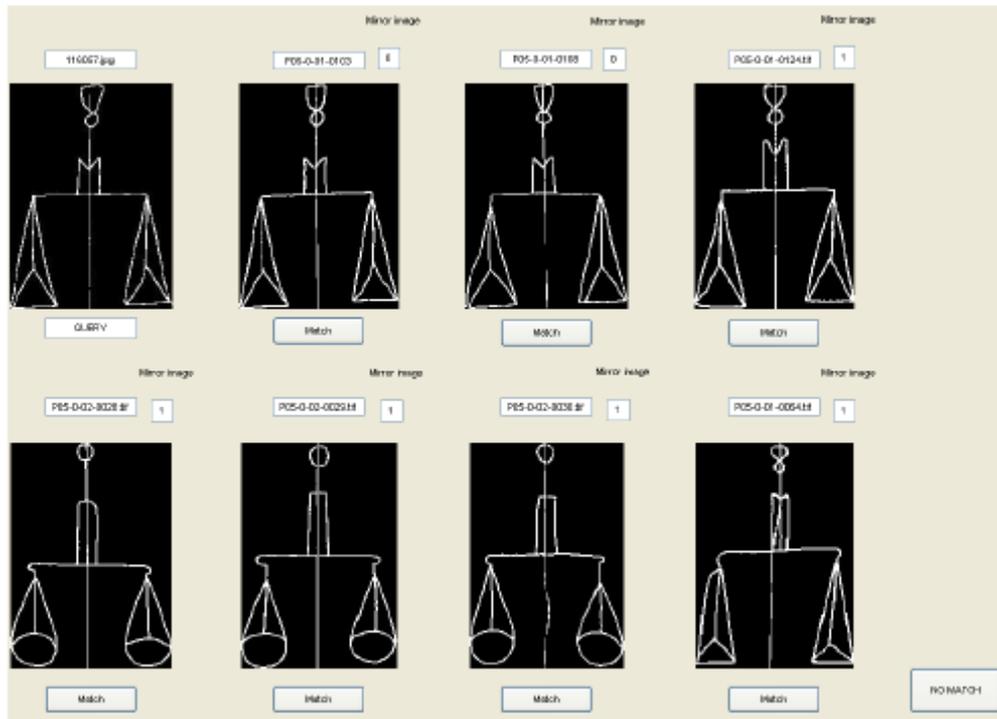


Figure 4: Seven most similar watermarks

The software tool provides for each watermark of one collection the seven most similar watermarks from the other collection. Afterwards the experts should decide whether they are identical or simply similar. The identification techniques were presented (by Héctor Moreu Ojal, Jan C. A. van der Lubbe) in the paper *Isolation and Identification of Identical Watermarks within Large Databases* at EVA Berlin, in November 2008.

### Software to discover identical pieces of paper based on laid and chain lines information

This is treated in the technical report [Paper retrieval based on specific paper features: Chain and laid lines](#). An online example is available under the following address: <http://rembrandt.ewi.tudelft.nl/index.php>

### Sieve variation experiment for evaluating present authentication and identification methods (svx)

The cornerstone of today's paper authentication and identification methods is the assumed similarity between two pieces of paper originating from the same mould as seen in the imprint of the sieve in the paper. During its lifespan (up to five years) the sieve gets distorted by the work process. The problem is to evaluate the range of variability introduced by this natural development in order to validate the expertise assumption and/or improve its performance. An experiment was conducted to this effect, in conjunction with the project collaborators at the paper and watermarks museum in Fabriano, Italy, where paper was hand-produced during a period of one and a half years. The results are presented in a technical document for guiding individuals doing paper expertise and a dataset for use in the expertise process, cf.: <http://www.bernstein.oew.ac.at/twiki/bin/view/Main/ImprintVariability>