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RAPID COMMUNICATION

The magnetic imaging of oil paintings

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Abstract
We propose a new technique for authentication of oil paintings, using a scanning SQUID technique to measure its magnetic field. The paintings are pre-magnetized in an homogeneous field of 100 G. It was observed that the response depends on the ferromagnetic properties of each paint independent of its colour. This shows that a magnetic image could be used as a magnetic signature for authentication purposes.

Conservation of an artistic patrimony in paintings includes the use of identification to assure authenticity in the recording of source and date of a specific piece of art. From this point of view, safe forms of authentication contribute to its preservation and conservation, and even prevent forgery. A new technique for authentication of some oil paintings is presented, based on the acquisition of the magnetic image of the painting, using a scanning SQUID (SSQUID) technique [1–3]. The use of magnetic imaging techniques is justified in getting a record because some of the minerals used to create the colour in oil paints present ferro(i)magnetic properties [4].

We chose the SQUID technique because it is very sensitive. Measurements in the SQUID magnetometer were made without any external field, just in the local geomagnetic field. To avoid any signals from past magnetization, a standard protocol was adopted before the measurement: the painting was magnetized in a homogeneous magnetic field of 100 G parallel to the canvas plane. The sample was then placed horizontally on a controlled mobile table and the measurements were performed with the SSQUID technique. A standard distance of 10 mm was used between the SQUID and the sample. Magnetization measurements were performed using a second order gradiometer with 15 mm diameter coils and 40 mm baseline coupled to the SQUID at 4.2 K.

Different samples from oil colour manufacturer trademarks Grumbacher, Pébéo and Maimeri were measured. We noticed that some of those oil colours are ferromagnetic. In the case of magnetic colours, the magnetic field produced by the paint depends on several variables, such as the paint thickness and the method of application (spot, paintbrush, etc). However, a pattern that looks like the field due to a magnetic dipole parallel to the plane of the sample was generally observed. Some colours, especially those composed of iron oxide pigments, are strongly ferromagnetic.

An experiment was performed to show that a magnetic image could be the signature of a complex oil painting. Three flower pictures were painted using a stencil technique. The first one was painted with a colour known as Mars Black (Grumbacher Pre-Tested® P-134). The second one was painted with a blend of Mars Black and Ivory Black (Grumbacher Pre-Tested® T-115). The last one was painted just with Ivory Black. The three pictures are visually very similar, as shown in figure 1. However, they produce totally different magnetic images (figure 1, bottom). The first picture produces two magnetic dipoles, one corresponding to the upper leaves, and the other corresponding to the lower leaves. (The second order gradiometer coil used is large compared to the

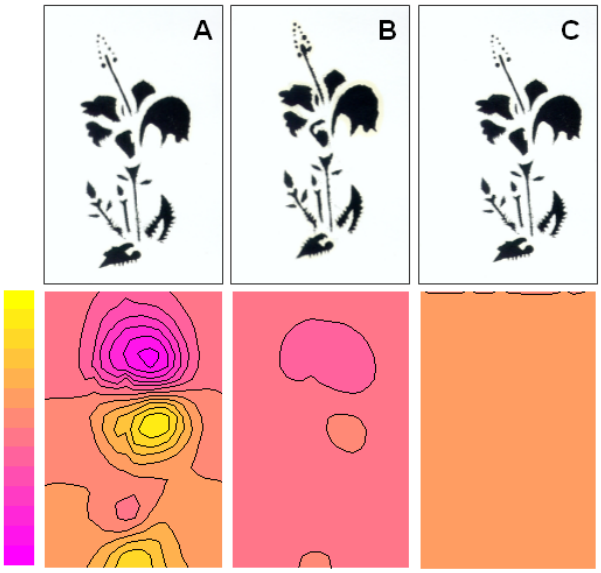

Figure 1. Three similar flower pictures painted using a stencil technique. (A): Stencil painted with Mars Black (top) and its magnetic image (bottom). (B): Stencil painted with a blend of Mars Black and Ivory Black (top) and its magnetic image (bottom). (C): Stencil painted with Ivory Black (top) and its magnetic image (bottom). Values on magnetic scale vary from −100 nT to 60 nT.

(This figure is in colour only in the electronic version)

leaves so they cannot be resolved individually.) The magnetic dipole is less intense in the magnetic image of the second picture, due to the blending of different types of black oil colours. The third picture shows no magnetic dipole, because Ivory Black is not magnetic. (Paramagnetic contributions were not considered here.) The maximum signal from the first sample is 5.9 nT, with a standard deviation of 0.2 nT, and the minimum value is −5.1 nT with a standard deviation of 0.4 nT. These results show that the magnetic image of similar visual paintings is different for each type of paint.

In conclusion, the results obtained here allow us to propose that magnetic imaging can be used as an authentication test and record for oil paintings.

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