Bringing Motion to Art Galleries: Scanning X-ray Fluorescence with Newport Linear Stages[1]

Elemental distribution maps are of great interest to the study of historical paintings as they allow investigation of the pigment use by the artist. They also enable imaging changes made in the painting during or after its creation and in some cases reveal hidden paintings that were over painted at a later time.

X-ray fluorescence (XRF) is a non-destructive technique to obtain elemental distribution maps of historical paintings. In scanning XRF, the painting is locally irradiated by means of an X-ray beam upon which the emitted fluorescence radiation is recorded with an X-ray detector. By moving the painting through the beam (or the beam over the painting), the entire surface of the painting can be scanned sequentially for compositional analysis.

Many historical paintings have been examined with XRF in various synchrotron facilities worldwide. However, in many cases, it can be more advantageous and cost-effective to bring the scanning XRF to the museum rather than taking the painting to a synchrotron beam line site. These mobile scanning XRF set-ups use an X-ray tube and can be transported to a museum for in situ investigations. The University of Antwerp, Belgium, developed and built several mobile scanning XRF instruments using Newport motorized linear stages to record elemental distribution maps in a fast, non-destructive and in situ manner. The motion systems consist of motorized XZ set-ups with the X-ray tube and up to 4 X-ray detectors mounted on the z-axis.

The mobile scanning XRF instruments include different types of X-ray tubes as well as four X-ray detectors with a typical weight between 10 and 20 kg. The axial load capacity of the vertical axis stage is therefore an important criterion. In order to achieve a larger scanning area, it is desirable to select the motorized linear stages to cover the largest travel distance possible.

Based on Newport's standard catalogue offering, an M-IMS600PP High Performance Linear Stage with 600 mm travel range was chosen for the x-axis. For an exceptional high axial load capacity of 200 N, an M-MTM250PE1 Long-Travel Steel Linear Stage was selected to provide the longest travel range in the vertical direction. In order to control the XZ setup with ease of operation, an ESP301 controller became a preferred choice with its convenient front panel interface and portability.

Fig. 1 shows the mobile scanning XRF set-up using Newport's motion control products in front of Vincent van Gogh's "Patch of Grass". The map of element Sb (Fig.2) obtained by scanning an area of 250 x 400 mm2 reveals information about the hidden portrait of a woman.

For more information, please contact Newport sales and applications engineers.

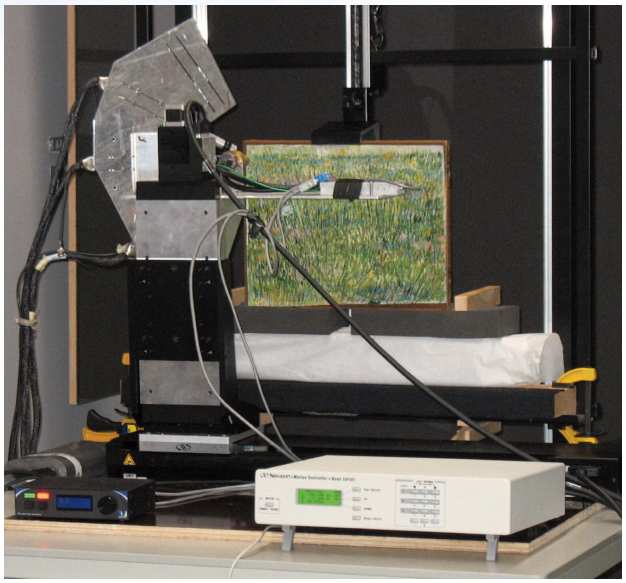

Fig. 1: Mobile XRF set-up during the investigation of "Patch of Grass"

Fig. 2: Elemental map obtained on Vincent van Gogh's "Patch of Grass" showing a hidden portrait of a woman; Sb distribution

1 Matthias Alfeld, Koen Janssens, Joris Dik, Wout de Nolf and Geert van der Snickt
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Optimization of mobile scanning macro-XRF systems for the in situ investigation of historical paintings

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