NEUTRON RADIOGRAPHY FOR CULTURAL HERITAGE OBJECTS IN IRAN

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Abstract

One of the interesting uses of radiography is in archeological and art applications. In this research, radiography was utilized for identification of a damaged art-historical material. For digital image processing, Gabor filter with automatic thersholding level were used. Radiography image obtained from this work showed a very clear picture of the original trace of hammered design. These result showed that a combination of radiography, image processing techniques and consideration of physical principles of radiation interaction with materials can produce a very clear image which can be used effectively for the detail analysis of cultural heritages.

1 Introduction

Neutron radiography (NR) is a useful technique in non-destructive testing (NDT) of cultural heritage objects. NR is complementary to X and gamma radiography. Generally, NDT methods are preferred to chemical methods because of less damage to antique work. Radiography was identified as a very important method that has a physical base and implicates no damage to the antique object. In the present study, a method based on radiographic imaging and image processing was developed for corrosion rate measurement and designs reconstruction of antique vase. The vase was from Samiran region of Qazvin Province, Iran. The age of the vase has been estimated 900 years old, approximately.

Fig.1 The antique vase from Samiran region of Qazvin Province, Iran.

3 Methods

NR is complementary to X and gamma radiography. A new NR beam line has recently been built at the Tehran Research Reactor (TRR) in order to expand the national applications of NR (Fig.1). The set up of equipment for NR of the antique vase is shown in Fig.2. The beam power was 3MW and the detector for image was CR plate. L/D parameter for this experiment was 150. The flux of neutron set at 10^6 and time was almost two minutes. The ordinary phosphor imaging plates or CR (Computed Radiography) plate was used. The imaging plates were scanned with laser spot size of 50 mm in the CR laser scanner.

Gabor Filter

The Gabor filters are useful tools for extracting spatially localized property. Modulating a sinusoid with a Gaussian kernel make the Gabor filters. This filter acts on some frequency only in a localized part of the image. Here, this filter with number of wavelet scales and filter orientations 6 were used and the wavelength of smallest scale filter were set to 0.5, $\pi/6$ and zero.

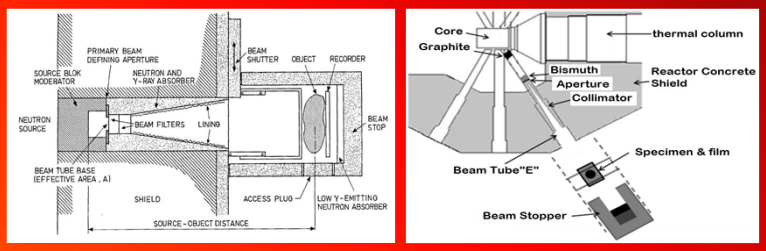


Fig.2 schematic of new beam at the Tehran Research Reactor (TRR)

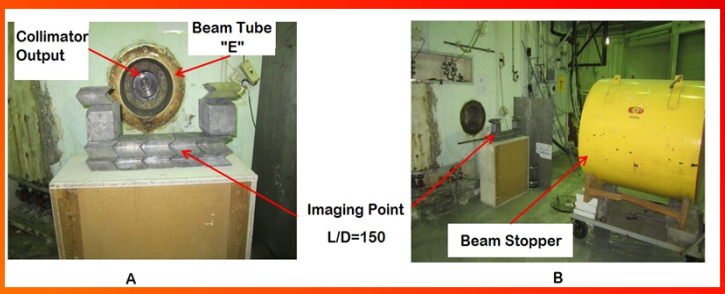
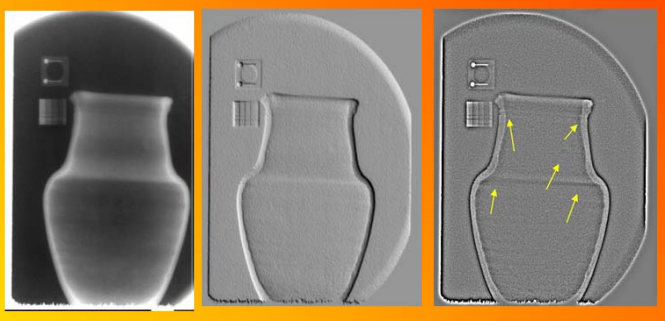


Fig.3 The set up of equipment for NR of the antique vase

3 Results

In this research, a historical vase has been radiographed by means of new neutron beam line of TRR. The digital neutron radiography technique was used by the CR plate. In fig. 4-A The original neutron radiography was shown. Here, two image processing method is utilized to remove the noise and enhance the contrast. The reconstructed image by contrast enhancement algorithm was shown in Fig 4-B. The image is clear than the original image. Also, The Gabor filter is use to extract the detail of image in Fig4. C.



A B C

Fig.4 A) The original neutron radiography B) reconstructed by contrast enhancement algorithm and C) reconstructed by Gabor filter

4 conclusion

This works was the first neutron radiography image of a cultural heritage object by the new NR facility at TRR. The results showed that the new system can be used effectively for the neutron radiography of cultural heritage objects.