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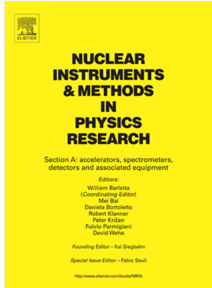

Reducing the spatial resolution range of neutron radiographs cast by thick objects

G.L. Almeida, M.I. Silvani, E.S. Souza, R.T. Lopes

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Reducing the spatial resolution range of neutron radiographs cast by thick objects

*Almeida, G. L, Silvani, M. I.
Instituto de Engenharia Nuclear, Reator Argonauta - CNEN
Rua Helio de Almeida 75, Cidade Universitaria, Ilha do Fundao
Caixa Postal 68550 CEP 21941-972 Rio de Janeiro - RJ, Brazil
gevaldo@ien.gov.br

Souza, E. S, Lopes, R. T.
Universidade Federal do Rio de Janeiro, COPPE, Centro de Tecnologia
Cidade Universitaria Bloco G, Ilha do Fundao, 21945-970 Rio de Janeiro - RJ, Brazil
msouza@ien.gov.br

* Corresponding author

ABSTRACT

The quality of a neutron radiograph is strongly dependent upon the features of the acquisition system. Most of them, such as detector resolution, electronic noise and statistical fluctuation can hardly be improved. Yet, a main parameter ruling the image spatial resolution, namely the *L/D* ratio of the system can be increased simply by lengthening the source-detector clearance. Such an option eventually may not be feasible due to neutron flux decreasing or engineering constraints. Under this circumstance, a radiograph improvement is only possible by some kind of after-acquisition procedure capable to retrieve, at least partially, the information concealed by the degradation process. Since the spoiling agent tied to the *L/D* has a systematic character, its impact can be reduced by an unfolding procedure such as Richardson-Lucy algorithm. However, that agent should be fully characterized and furnished to the algorithm as a *Point Spread Function - PSF* unfolding function. A main drawback of unfolding algorithms like Richardson-Lucy is that the *PSF* should be fixed, i.e., it assumes a certain *constant* image spatial resolution, rather than a variable one as actually occurs for thick objects. This work presents a methodology to minimize this difficulty by making all planes of the inspected object to cast a resolution within the shorter gap comprised between the object central plane and the detector. The image can then be unfolded with a lower resolution within a *tighter* range, yielding a better quality. The process is performed with two radiographs, where one of them is acquired with the object turned by 180^o on its vertical axis with regard to the other. After a mirroring of one of them about its vertical axis, the images are added. As the resolution increases linearly with the object-detector gap, it would remain always *lower* than that of the central one. Therefore, the overall resolution of the composite radiograph is enhanced. A further improvement can then be achieved through an efficient unfolding since the object has been virtually *shrunk* along the neutron path.

Key words: Neutron radiograph, spatial resolution, deconvolution.

1. Introduction

As ruled by pinhole optics, neutron radiography suffers mainly the effect of the penumbra which degrades the quality of the final images. Although its impact could be reduced by increasing the *L/D* ratio of the acquisition system, this would diminish the neutron flux, enlarging the statistical dispersion. Moreover, a lengthening of the source-detector distance could be unfeasible due to engineering or radiological protection constraints. Other entities such as detector resolution, electronic noise and neutron scattering - unlike penumbra which