Non-destructive assay employing 2D and 3D digital radiographic imaging acquired with thermal neutrons and reactor-produced radioisotopes

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The inner structure of some pieces of equipments or components can only be visualized by using suitable techniques, specially when safety reasons or expensive costs preclude the application of invasive procedures. The kind of agent capable of rendering an object at least partially transparent depends on the size and constitution of the object itself and on the availability of a detector sensitive enough to the agent as well. As a rough rule of thumb, light materials are transparent to gamma and X-rays while the heavy ones are transparent to neutrons, and hence, these types of radiation are complementary. When they hit a proper 2D detector, a radiograph is produced representing a convoluted cross section - usually called projection - of the object placed between the source of radiation and the detector. Taking a large number of such projections for different object attitudes, it is possible to reconstruct the spatial inner structure of the object as a 3D map of attenuation coefficients, i.e., a 3D tomography. This procedure however, besides a time-consuming task, requires specially tailored equipment and software, not always available or affordable. Yet, in some circumstances it is feasible to replace the 3D tomography by a stereoscopy, allowing one to visualize the spatial configuration of the object under analysis. In this work, both 2D and 3D, radiographic images of some objects have been acquired using thermal neutrons and radioisotopes produced by a reactor as a source of radiation and proper imaging plates as detector and storage devices. The stereographic vision has been achieved by taking two radiographs [1] of the same object at different angles from the detector point of view. Once exposed, the imaging plates have been *developed* by scanning with a 50 μm diameter laser beam in the model BAS 2500 image reader from FUJI, yielding digital images. After a treatment to render them red-white and green-white they were properly merged to yield a single image in a digital format capable of being watched in a monitor, or in a printed paper, with red-green glasses. All the image treatment and rendering has been performed with the software *ImageJ*. Stereographic images of several objects such as turbine stator blade, film photo-camera, variometer, altimeter and automotive pressure probe have been acquired showing their spatial inner structure.

References

[1] Silvani, M. I., Almeida, G. L. Rogers, J. D., Lopes R. T., "Stereoscopic Radiographic Images with Thermal Neutrons", Nuclear Instruments and Methods in Physics Research A,http://dx.doi.org/10.1016/j.nima.2010.09.051