1.4.5. INVESTIGATION OF SPATIAL-TIME CHARACTERISTICS OF RADIATION DETECTORS BACKSCATTERING FROM THE MULTICHANNEL COLLIMATOR

Belkin D.S., Kapranov B.I.,
Research Institute of Tomsk Polytechnic University, Tomsk, Russia

Computer tomography using inverse scattering is increasingly used for the purposes of non-destructive testing and diagnostics. Often the problem occurs in accessing the object of testing when you need a one-side access, because of its size, the inability to deactivate and delete any node from the production cycle. In such cases, the appropriate method of imaging based on inverse Compton scattering is used. Among the objects of testing, a study which is only possible with the use of tomography to scattered radiation, are the following: control of multilayer shells of torpedo boats, searching for the hull or deck bearing beams, bracing, study the dynamics of external influence on protection in aviation, shipbuilding, building of many products in the rocket and space technology, etc.

In the general case of tomographs for backscatter include source and detection system for scattered radiation, as shown in fig. 1.

The number of registered photons scattered from a particular voxel, proportional to its density ρ, linear coefficient of scattering μ_c and depends on the density distribution of the source path $\rho(l_1)$ and the way which goes to the scattered radiation detector $\rho(l_2)$. The problem of reconstruction is gating photons scattered from a specific voxel, and compensation for the influence of density on the path of propagation of radiation in its weakening. Breeding is carried out either by using special systems collimation source – scintillator, or by using the coordinate-sensitive detectors. Compensation ease – only programmatically.

A collimator uses slotted, cylindrical, honeycomb collimator and pinhole. Collimator provides unambiguous transfer point on the object of control to a point in the space of observations. In the simplest case, he performed as a lead plate with a hole corresponding to the size of the input window detector. Fig. 2 shows the radioscopy scheme using a slit collimator and radiation source Pinhole detector input window.

Fig. 3 (a) and (b) is one element of a collimator cell (a set of alternating absorbing and avoid artificial plates (channel) diameter 0.1 mm) and the geometry of the radiation passing through the plate.

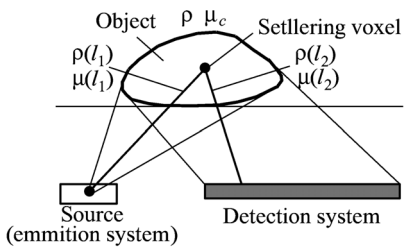


Fig. 1. The overall case detection

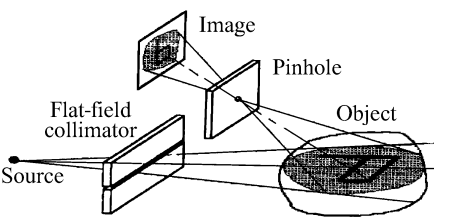
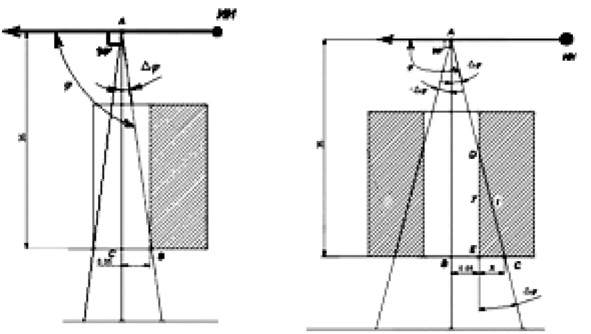


Fig. 2. Radioscopy scheme scattered radiation with the use of collimation



(a) (b)

Fig. 3. The geometry of the radiation passing through the collimator

Resolution tomographs with different collimation systems (cylindrical, conical, honeycomb collimator, circular and slotted Pinhole) determined aperture function, which is a response system to permit relatively thin plate displacement in the zone of "visibility" detector.

Aperture function is numerically equal to the number of photons registered detector tomograph, while the thin scattering plate in the x coordinate. Theoretically aperture function is defined on the entire range of x. However, the range of meaningful values, which determines the resolving power, can take a finite (0 hr). The value of hr and the aperture determines the resolution tomograph. Based on the considered geometry and calculations the final function was calculated (fig. 4).

The result of the work was the development of new technologies for the collection device multichannel collimator for spatial sampling of scattered radiation. Collimator is a set of absorbing and avoid materials. As the material used transmits fishing-line diameter of 0.5 mm, and as a material sink copper wire with a diameter of 0.5 mm. Clearly the device and its components are shown in fig. 5.

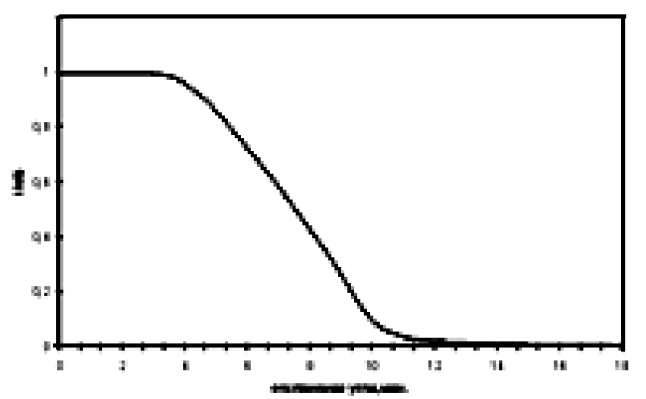


Fig. 4. Aperture function

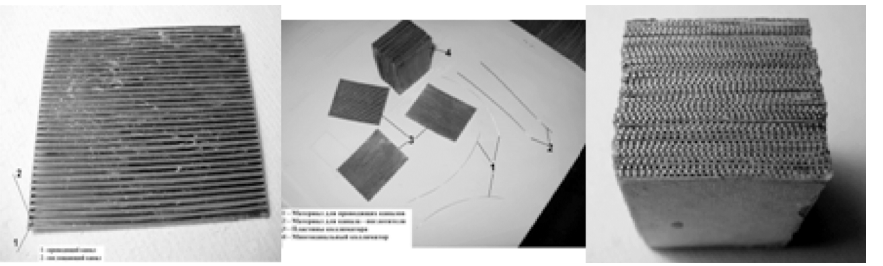


Fig. 5. Cross-collimator device and its components