1.9.31. NON-COLLIMATED SCATTERED RADIATION TOMOGRAPHY

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For most X-ray scattering tomography, based on collimated initial and scattered radiation, the distribution of the object density (linear scattering coefficient) is reconstructed by the number of counted photons scattered in the reconstructed voxel. Heterogeneous structures along the initial path and trajectory of counted scattered photons causes significant errors in imaging. Collimation of the initial and scattered radiation allows the detection of relatively few scattered photons. That is why the statistics relative to this process and the resolution are very poor.

The use of large detectors in non-collimated radiation tomography allows recording of substantial portion of scattered radiation (including multiple scattered photons). If it is possible to surround the object with the detector, almost 100% of the photons scattered and emitted beyond the object boundaries can be counted.

The object is represented in the form of a collection i, j voxels, within which the linear scattering coefficient (density) can be taken as a constant value.

The linear scattering coefficient distribution of the object $\mu(i, j)$ can be calculated from the algebraic system of equations of albedo radial sums (response function)

$$\sum_{i=f(x)} \mu(i,\ j)\, \Delta L(i,\ j) = S(x_0,\ y_0,\ \omega_0). \tag{1}$$

An array of albedo radial sums $S(x_0, y_0, \omega_0)$ along the initial trajectories can be obtained from the recorded scattered radiation intensity $N(x_0, y_0, \omega_0)$, measured at different angles ω_o and coordinates x_o, y_o of the initial beam radiation as:

$$S(x_0, y, \omega_0) = \frac{1}{k} \ln\left(\frac{N_0}{N_0 - \dfrac{k}{\alpha(x_0,\ y_0,\ \omega_0)} N_d(x_0,\ y_0,\ \omega_0)} \right) \tag{2}$$

where N_0 is the initial number of photons, k is complete attenuation coefficient for Compton scatter coefficient ratio, $\alpha(x_0, y_0, \omega_0)$ is the share of recorded photons among the total amount of photons scattered in vector (x_0, y_0, ω_0).

The value of $\alpha(x_0, y_0, \omega_0)$ depends on the position and size of the detector and on the density distribution, and can be determined by simulation during the object reconstruction.

Thus, the problem is reduced to solving a linear system of equations with unknown linear scattering coefficients $\mu(i, j)$.

The simulations has confirmed possibility of the above mentioned procedure for various samples [1, 2].

Figure 1 presents experimental result of the plastic gear reconstruction jn the base of non-collimated scattered radiation tomography.

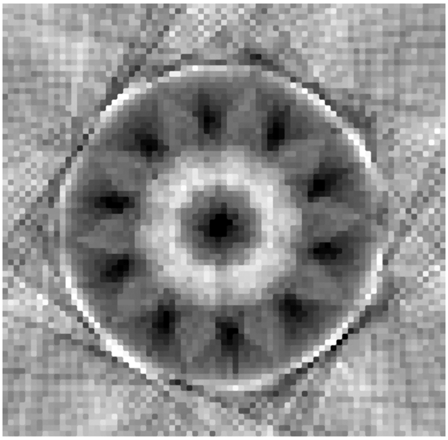

Fig. 1

References:

1. **Gorshkov V.A., Kröning M., Anosov Y.V., Kuzelev N.R., Yumashev V.M., Kosarev L.I., Samossadny V.T., Miloserdin V.Yu.** X-ray tomography on the base of non-collimated Radiation // Computed Tomography and Image Processing for Industrial Radiology. – Berlin. – 2003. – P. 9.

2. **Gorshkov V.A., Kröning M., Anosov Y.V., Dorjgochoo O.** X-ray scattering tomography // Nondestructive Testing and Evaluation. – 2005. – Vol. 20. – № 3. – P. 147 – 157.