TERAHertz TOMOGRAPHY: ALGORITHMS AND EXPERIMENTAL SETUP

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At tomography implementation in a terahertz range strong diffraction effects do not allow using the methods well fulfilled for X-ray tomography. In this paper numerical simulations of tomography projections measurements are accomplished and diffraction tomography iterative algorithm is developed. Generalization of one of the most perspective algorithms of iterative type, - algorithm Gerchberg-Papoulis (G-P) [1], from X-ray on a diffraction tomography is performed. Experimental methods of tomography projections measurements in a terahertz range are developed.

At the heart of the G-P method iterative usage of Fourier-synthesis method lays. Here two spaces participate in iterations: Fourier-space and image space of the tomogram. Known relations between Fourier transform of the wave picture recorded on the flat detector and the Fourier transform of unknown complex refraction index distribution employing the Born or Rytov approximation [2], allows to fill out Fourier-space of the tomogram in iterations and then by inverse Fourier transform to receive the required tomogram. On each iterative step a priori information on an image in the given space is applied (see figure 1).

**Figure 1.** Example of reconstruction of the two-dimensional model tomogram by G-P algorithm. At the left from above – exact model, on the right – its reconstruction on 73 projections, 15 iterations, and RMS error - 33.7 %. Dimensions of the tomogram – 129x129. The bottom row: reconstruction of the three-dimensional model phantom by its two-dimensional projections. At the left – exact model, on the right – its reconstruction. Dimensions of the tomogram – 65x65x65.

**Figure 2.** Trial measurements of tomographical projections of several amplitude and phase objects have been accomplished at two wavelengths of FEL – 68 and 130 microns.

The greatest possible working field of the detector is 75x75 mm. This size allows to record projections of amplitude and phase objects without scanning. Example of the experimental projection for amplitude object is presented in figure 2, wavelength $\lambda=130 \ \mu$.

In summary it is necessary to note high quality of model objects reconstruction by a few-view Gerchberg-Papoulis algorithm developed in this work, both in two-dimensional, and in three-dimensional diffraction tomography. This work was partially supported by the RFBR grant 09-02-12158.


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