

Reconstruction of 3D Objects Containing Spheres and Cylinders from a Few Projections

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The following problem has been studied during non-destructive testing: A 3D object consisting of homogeneous materials is to be reconstructed from its projections (e.g. from X-ray or neutron radiographs). The object is a tube enclosing some solid spheres or cylinders (such as balls, pipes). It should be taken into account that the projections are distorted due to noise, while the aim is to reconstruct the object using as few projections as possible.

Our solution strategy reformulates the reconstruction problem as an optimization task. A configuration of cylinders and spheres is to be found whose projections are different from the input measurements as small as possible. It is measured using the sum of squared differences. In order to accelerate the algorithm and to ensure a successful reconstruction, the procedure starts by building a suitable initial configuration, and approaches the solution iteratively. The implemented algorithm is based on simulated annealing. To test the efficiency of our method, the program has been incorporated into the system DIRECT being developed at our department. DIRECT is a framework for studying various discrete tomographic methods. In simulated and physical experiments we investigated the effects of several parameters: number of projections, noise level, and complexity of the object to be reconstructed. We present some experiments and results of the algorithm.