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Relaxation Methods for Image Reconstruction

Gabor Herman, Arnold Lent, Peter Lutz
The State University of New York at Buffalo

Abstract:

The problem of recovering an image (a function of two variables) from experimentally available integrals of its grayness over thin strips is of great importance in a large number of scientific areas. An important version of the problem in medicine is that of obtaining the exact density distribution within the human body from X-ray projections. One approach that has been taken to solve this problem consists of translating the available information into a system of linear inequalities. The size and the sparsity of the resulting system (typically, 25,000 inequalities with fewer than 1 percent of the coefficients nonzero) makes methods using successive relaxations computationally attractive, as compared to other ways of solving systems of inequalities. In this paper, it is shown that, for a consistent system of linear inequalities, any sequence of relaxation parameters lying strictly between 0 and 2 generates a sequence of vectors which converges to a solution. Under the same assumptions, for a system of linear equations, the relaxation method converges to the minimum norm solution. Previously proposed techniques are shown to be special cases of our procedure with different choices of relaxation parameters. The practical consequences for image reconstruction of the choice of the relaxation parameters are discussed.

Keywords:

Image Reconstruction, Image Processing, Computing Methodologies, Segmentation