CONVEX PENALIZED ALGEBRAIC RECONSTRUCTION TECHNIQUES

QINIAN JIN

Abstract. Algebraic reconstruction techniques (ART) are a family of iterative algorithms used in computed tomography. According to their nature, they can be divided into two classes: sequential algorithms and simultaneous algorithms. As representative ones, they include the Kaczmarz's algorithm, the Cimmino's algorithm, the simultaneous algebraic iterative technique (SART), the component averaging (CAV) algorithm, and the diagonally relaxed orthogonal projection (DROP) method. In case the problem is consistent, these algorithms converge to weighted minimal norm solutions. However, these algorithms show smoothing effect which produces undesired artifacts and thus blurs the reconstruction results. In order to weaken the smoothing effect, we propose new iterative algorithms by incorporating non-smooth convex functions into the classical algorithms as penalty terms. Each iteration of our methods consists of two steps: the first step involves only the classical ART procedure while the step involves only the penalty term. This splitting character makes the implementation efficient. By using tools from convex analysis, we provide the convergence analysis and establish the regularization property of our methods. Numerical simulations on computed tomography are presented to illustrate the performance.

Mathematical Sciences Institute, The Australian National University, Canberra, ACT 0200, Australia

E-mail address: Qinian.Jin@anu.edu.au