

论文

光学层析技术中常见迭代重建算法的误差分析

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摘要:

为了得到较好的重建结果,对光学层析技术中常见迭代重建算法中的代数重建算法(ART)和同时迭代重建算法(SIRT)的重建参数进行分析,通过选择重建参数和计算机数值模拟达到重建要求。计算机数值模拟证明了松弛因子的选择对迭代重建算法的重建结果有非常重要的影响。在ART算法中,其他重建条件一定,松弛因子太大或太小时重建误差都会增大,松弛因子在0.4~1.5范围内时重建精度基本满足要求,最优松弛因子约为0.8;在SIRT算法中,松弛因子在4~12范围内时重建精度基本满足要求,最优松弛因子约为12。总结出代数重建算法和同时迭代重建算法不同条件下松弛因子选择的规律。在ART算法中,投影方向数增加松弛因子减小,每方向投影数与重建分辨率对松弛因子无影响,松弛因子一定的情况下,投影数太小或太大误差会增大。在SIRT算法中,投影方向数增加松弛因子减小,并且投影方向数增加一倍最优松弛因子约减小为原来的50%;每方向投影数增加最优松弛因子减小,且投影数增加一倍,最优松弛因子约减小原来的50%;重建分辨率增加,最优松弛因子增加。

关键词: 光学层析;迭代重建算法;重建参数;误差分析

Error analysis of common iterative reconstruction algorithms in optical chromatographic technique

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Abstract:

In order to get the perfect reconstruction result, the reconstruction parameters of the common iterative algorithms as ART and SIRT used in the optical chromatographic technique are analyzed. The reconstruction requirement was satisfied by selecting the appropriate reconstruction parameters, comparing the reconstruction errors (average error, max error, root-mean-square error), and implementing the computer numeric simulation. This simulation proves that the selection of relaxation factors has a very important influence on the iterative reconstruction algorithms. In ART, while the other conditions are unchanged, the relaxation factor range from 0.4 to 1.5 can meet the requirement of reconstruction accuracy basically and the best selection is 0.8. In SIRT, the relaxation factor range from 4 to 12 is appropriate and 12 is the best selection. The influence of the relaxation factor on the iterative reconstruction algorithms was studied, and the selection law of the relaxation factor under different conditions was summarized in the algebraic reconstruction technique and simultaneous iterative reconstruction technique. In ART, the relaxation factor will decrease if the number of projection direction increases but the number of each direction projection and reconstruction resolution have no influence on it, and the error will increase if the number is too big or too small while the relaxation factor is unchanged. In SIRT, the relaxation factor will decrease if the number of projection direction increases, and the optimal relaxation factor will decrease 50% if it increases 2 times; the optimal relaxation factor will decrease if the number of every direction projection increases, and the optimal relaxation factor will decrease 50% if it increases 2 times; the relaxation factor will increase if the reconstruction resolution increases.

Keywords: optical chromatographic technique; iterative reconstruction algorithm; reconstruction parameter; error analysis

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