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论文

基于Tikhonov正则参量后验选择策略的PCS颗粒粒度反演方法

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摘要:

采用基于Morozov偏差原理的后验策略来选择最优正则参量,并采用此方法对单峰和多峰分布颗粒系的模拟电场自相关函数进行了反演,结果表明,对于单峰颗粒体系,当电场自相关函数的扰动误差小于0.05时,反演得到的峰值准确,当电场自相关函数的扰动误差大于0.05时,反演得到的峰值偏离所模拟的颗粒粒径.正则参量初始值在0.000 02～2范围内,在反演所得的峰值准确的基础上,正则参量初始值越小,反演得到的分布宽度越窄.收敛误差在0.000 05～50范围内,在保持反演结果稳定的基础上,收敛误差取值越大,反演得到的分布宽度越窄.对于多峰颗粒体系,当颗粒系中的颗粒粒径差别较小时,峰值向平均值偏移,当颗粒系中的颗粒粒径差别较大时,小颗粒粒径分布以噪音的形式出现.

关键词: 光子相关光谱 Tikhonov正则化方法 Morozov偏差原理 后验选择策略

A Posterior Choice Strategies of the Tikhonov Regularization Parameter in the Inverse Algorithm of the Photon Correlation Spectroscopy Particle Sizing Techniques

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Abstract:

A Posteriori Choice Strategies based on Morozov discrepancy principle is adopted in order to choose the Optimum Regularization Parameter in the Inverse Algorithm of the Photon Correlation Spectroscopy particle sizing techniques.Using the method analyzed the simulation experimental data of single peake and multimodel peak particles system are analyzed.For the single peake particles system,the peake value is correct when the noise of the experimental data varies from 0 to 0.05.The peake value is incorrect when the noise of the experimental data is greater than 0.05.The distributing width decreases with the decrease of the original value of Regularization Parameter when the original value of Regularization Parameter varies from 0.000 02 to 2.The distributing width decreases with the increase of the convergence error when the convergence error varies from 0.000 05 to 50.For the multimodel peak particles system,the peak value incline to the average value when the particles diameter discrepancy is small.The smaller particle size distributing appear as the noise when the diameter discrepancy is large.

Keywords: Photon correlation spectroscopy Tikhonov regularization method Morozov discrepancy principle Posterior choice strategies

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参考文献:

[1] PECORA R.Dynamic light scattering: application of photon correlation spectroscopy [M].New York: Plenum Press,1985.

[2] WANG Nai-ning.The application of the optical measurement technique of particles [M].Beijing: Atomic Press,2000.
王乃宁.颗粒粒径的光学测量技术及应用 [M].北京：原子能出版社,2000.

[3] KOPPEL D E.Analysis of macromolecular polydispersity in intensity correlation spectroscopy: The method of Cumulants [J] .J Chem Phys,1972 ,57 (11) : 4814-4820.
[4] GULARI E,GULARI E,TSUNASHIMA Y,et al.Photon correlation spectroscopy of distribution [J] .J Chem Phys,1979,70 (8) : 3965-3972.
[5] OSTROWSKY N,SOMETTE D,PARKER P,et al.Exponential sampling method for light scattering polydispersity analysis [J] .Journal of Modern Optics,1981,28 (8): 1059-1070.
[6] MCWHIRTER J G,PIKE E R.On the numerical inversion of the Laplace transform and similar Fredholm integral equations of the first kind [J] .J Phys A: Math Gen,1978,11 (9) : 1729-1745.
[7] DHADWAL H S.Regularized inversion of the Laplace integral equation-polydispersaty analysis in photon corredation spectroscopy [J] .Part Part Syst Charact,1989,6 (1) : 28-33.
[8] HONERKAMP J,WEST J.Determination of the relaxation spectrum by regularization method [J] .Macromolecules,1989,22 (11):4372-4377.
[9] PROVENCHER S W.A constraine` regularization method for inverting data represented by linear algebraic or integral equations [J] .Bomputer Physics Communications,1982,27 (1) : 213-227.
[10] PROVENCHER S W.A Fourier method for the analysis of exponential decay curves [J] .Bio Phys,1976,16 (1): 27-41.
[11] PROVENCHER S W.An eigenfunction expansion method for the analysis of exponential decay curves [J] .J Chem Phys,1976,64 (7): 2772-2777.
[12] PROVENCHER S W,HENDRIX J,MAEYER L D,et al.Direct determination of molecular weight distributions of polystyrene in cyclohexane with photon correlation spectroscopy [J] .J Chem Phys,1978,69(9) : 4273-4276.
[13] PROVENCHER S W.Inverse problems in polymer characterization: Direct analysis of polydispersity with photon correlation spectroscopy [J] .Makronlol Chem,1979,180(1): 201-209.
[14] PROVENCHER S W.CONTIN Users Manual [G] .EMBL Technical Report DA05,European Molecular Biology Laboratory,Heidelberg,1982.
[15] XIAO Gen-ting,YU Shen-gen,WANG Yan-fei.The solving method of inverse problem [M] .Beijing:science publishing company,2003.
肖庭延,于慎根,王彦飞.反问题的数值解法 [M] .北京:科学出版社,2003.
[16] WANG Huai-ye,ZHANG Ke ,LI Yan-jun.Selection of regularization parameter for anisotropic diffusion filtering [J] .Acta Photonica Sinica,2005,34 (9) :1411-1414.
王怀野,张科,李言俊,各向异性扩散滤波的正则化参量选取方法 [J] .光子学报,2005,34 (9) :1411-1414.
[17] JIN Qi-nian.The saturation character,contradictorily result and posterior parameter choice of the tikhonov regularization [J] .Science in China,1999,29(8): 715-723.
金其年.Tikhonov正则化的饱和性与逆结果及后验参量选取 [J] .中国科学,1999,29(8):715-723.
[18] MOROZOV V A.On regularization of ILL-posed problems and selection of regularization parameter [J] .Comp Math Math Phys,1966,6(1) : 170-175.
[19] WANG Ya-jing,ZHENG Gang,SHEN Jin,et al.Computer Simulation of Bimodal Distribution Superfine Particles Dynamic Light Scattering and Precision Analysis [J] .Acta Photonica Sinica,2009,38(9):2337-2342.
王雅静,郑刚,申晋,等.双峰分布的超细颗粒动态光散射信号模拟及精度分析 [J] .2009,38(9):2337-2342.

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2. 刘桂强 杨冠玲 岳成凤 何振江 周述苍 喻雷寿.纳米颗粒光子相关测定中基线方法对测量结果的影响[J]. 光子学报, 2008,37(2): 370-374
3. 韩秋燕 申晋 宋景玲 杨淑连.PCS颗粒测量技术中的累积分析方法研究[J]. 光子学报, 2008,37(12): 2525-2528

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