数学与系统科学研究院

计算数学所学术报告

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报告题目：

Newton–Conjugate–Gradient Methods for Solitary Wave Computations

邀请人： 袁亚湘研究员

报告时间： **2009 年 7 月 7 日(周二)**

下午 3:30—5:00

报告地点： **科技综合楼三层 311**

计算数学所报告厅

Abstract:

Solitary waves are stationary localized solutions of nonlinear wave equations. They play an important role in the studies of nonlinear wave phenomena in physics and engineering, thus their computation is an important issue. In this talk, I will first review a few prominent existing iteration methods for computing solitary waves in nonlinear wave systems. Then I will propose Newton–conjugate–gradient (Newton–CG) methods for their computations. These Newton–CG methods are based on Newton iterations, coupled with conjugate gradient iterations to solve the resulting linear Newton–correction equation. When the linearization operator is self–adjoint, the preconditioned conjugate gradient method is proposed to solve this linear equation. If the linearization operator is non–self–adjoint, the preconditioned biconjugate

gradient method is proposed to solve the linear equation. The resulting methods are applied to compute both the ground states and excited states in a large number of physical systems such as the two–dimensional NLS equations with and without periodic potentials, the fifth–order KdV equation, and the fifth–order KP equation. Numerical results show that these proposed methods are faster than the other leading numerical methods, often by orders of magnitude. In addition, these methods are very robust and always converge in all the examples being tested. Furthermore, they are very easy to implement. It is also shown that the nonlinear conjugate gradient methods are not robust and inferior to the proposed methods.

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