数学与系统科学研究院

计算数学所学术报告

(定期学术报告)

报告人： 孙雅娟副研究员

(ICMSEC)

报告题目：

Continued fractions and the stability of Partitioned Runge–Kutta methods

报告时间： **2009 年 5 月 14 日(周四)**

下午 4:00—5:00

报告地点： **科技综合楼三层 311**

计算数学所报告厅

Abstract：

Traditionally in stability analysis of numerical methods for ODEs, we study the Dahlquist equation as a test equation. The stability of the numerical

method is then derived by studying its stability function. However, this technique is not appropriate when a numerical method is applied to a partitioned system of ODEs. In particular, the Partitioned Runge−Kutta methods, obtained by applying Runge−Kutta methods to partitioned system separately, can not be analyzed by considering a single stability function. Instead, the notion of a ``stability matrix'' must be introduced and we must consider what happens when the method is applied to the normal form of the ODEs rather than the Dahlquist equation. For example, when a symplectic Lobatto IIIA−IIIB pair is applied to a 2D linear Hamiltonian ODEs, McLachlan and Ryland in [4] presented two possible normal forms for study： a separable Hamiltonian system and a non−separable Hamiltonian system. Jay and Petzold in [3] considered the application of symplectic Lobatto IIIA−IIIB pair to the separable linear Hamiltonian system and gave close forms for the stability matrix and its trace (which is related to the stability of the PRK pair) by the generalized W

transformation from Grimm and Scherer in [2].

In this talk, we first present a background material concerning the development of stability theory for Runge−−Kutta methods and Lobatto IIIA−IIIB pairs. We then extend the aforementioned results from Jay and Petzold in [3] by presenting simplified expressions for the trace of the stability matrix. We also connect this to Pad é approximants and continued fraction expansion, which allows us to discuss the asymptotic behavior of the trace of the stability matrix as a function of the stage value of the Lobatto pair.

This work is joint research in development with Prof. Robert McLachlan (Massey University, New Zealand) and Dr. Priscilla Tse (AMSS, China).

<u>References:</u>

[1] B. Ryland, R.McLachlan and J. Frank. On the multisymplecticity of partitioned Runge−−Kutta and splitting methods, International Journal of Computer Mathematics, 84(6): 847−−869 (2007).

[2] V. Grimm and R. Scherer. A generalized W−transformation for constructing symplectic

partitioned Runge−−Kutta methods. BIT Numer. Math., 43, 57—66, (2003).

[3] L. O. Jay and L. R. Petzold. Highly oscillatory systems and periodic stability. Preprint, (1995).

[4] R. McLachlan and B. Ryland. Partitioned Runge−Kutta methods in space and time. Issac Newton Institute, UK, (July 2007).

欢迎大家参加！