数学与系统科学研究院

计算数学所学术报告

报告人： Prof. Arieh Iserles

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报告题目：

Skew-symmetric differentiation matrices and spectral methods on the real line

邀请人： 洪佳林 研究员

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下午 16:00-17:00

报告地点： 数学院南楼二层

222 教室

Abstract:

A most welcome feature of orthogonal bases employed in spectral methods is that their differentiation matrix is skew symmetric, since this makes energy conservation automatic in conservative time-evolving problems. A familiar example is given by Hermite functions, which are dense in $L(-\infty,\infty)$ and give raise to a skew-symmetric, tridiagonal differentiation matrix.

In this talk, describing joint work with Marcus Webb (KU Leuven), we present full characterisation of all orthogonal systems acting on $L2(-\infty,\infty)$, dense either there or in a Paley—Wiener space, and that have a differentiation matrix which is skew-symmetric, tridiagonal and irreducible. We also present a constructive algorithm for their generation — essentially, given any symmetric Borel measure on $(-\infty,\infty)$ or on $(-a,a)$ for some $a>0$, there exists a unique (up to rescaling) basis of this kind and it can be generated constructively. We conclude with a number of examples, related to Konoplev, Carlitz and Freud measures.

Finally, we address the more general question of skew-Hermitian differentiation matrices. This brings us to very recent work on a variant of Malmquist—Takenaka basis, which appears to tick every desirable box: an orthonormal system dense in $L2(-\infty,\infty)$, with tridiagonal skew-Hermitian differentiation matrix and whose generalised Fourier coefficients can be computed with a single FFT.

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