Research

Colloquium

Numerical evidence for the $L^{\mathcal{P}}$-norm blow-up

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摘　要：

We consider those evolution equations whose solutions blow up in finite time T in the sense that $\|u(t,\cdot)\|_\infty \to \infty$ as $t \to T$. Here, $u(t,x)$ denotes the exact solution of the evolution equation under consideration. Such problems are often called blow-up problems and the finite time is called the blow-up time. Although the L^∞-norm for the solutions of such problems becomes unbounded in a finite time T, the L^p-norms $(1 \le p < \infty)$ do not always blow up simultaneously. However, for the numerical computation of blow-up problems, if we consider time-independent spatial partitions for a bounded domain to compute blow-up solutions, the unboundedness for the discrete L^∞-norm of the numerical solution is equivalent to the unboundedness of any other discrete L^p-norms $(1 \le p < \infty)$ for the numerical solutions. That is, all discrete L^p-norms blow up simultaneously while the L^p-norms of the exact solution may remain bounded as $t \to T$. This shows the numerical difficulty in the computation of L^p-norms of the blow-up solutions which remain bounded as $t \to T$. We would like to explore in this talk such a problem by a simple model equation axisymmetric semi-linear heat equation. Some remarks on the numerical blow-up solutions of axisymmetric semi-linear equation will also be reported.