A fast algorithm for computing the mock-Chebyshev interpolation

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Abstract

A very well-known example known as Runge Phenomenon published by C. Runge in 1901 is as follows: polynomial interpolation of a function f, using equidistant interpolation points on $[-1, 1]$ could diverge on certain parts of this interval even if f is analytic anywhere on the interval. Among all the techniques that have been proposed to defeat this phenomenon in the literature of approximation theory, there is the mock-Chebyshev interpolation on a grid: a subset of $(n + 1)$ points from an equispaced grid with $O(n^2)$ points chosen to mimic the non-uniform $(n + 1)$-point Chebyshev-Lobatto grid [1].

This study suggests a fast algorithm for computing the mock-Chebysev nodes using the distance between each of the two consecutive points. The complexity of the algorithm is $O(n)$, where $n+1$ is the number of the Chebyshev nodes on the interval $[-1, 1]$. A discussion of bivariate generalization of the mock-Chebyshev nodes to the Padua interpolation points in $[-1, 1]^2$ is given and numerical results are also provided.

References

[1] *J.P. Boyd, F. Xu,* Divergence (Runge Phenomenon) for least-squares polynomial approximation on an equispaced grid and MockChebyshev subset interpolation. Appl.Math.Comput. **210** (2009) 158–168.