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The method of C. W. Clenshaw and A. R. Curtis [Numer. Math. 2, 197-205 (1960; Zbl 0093.140)] for numerical integration is extended to semimfinite \([0, \infty]\) and infinite \([-\infty, \infty]\) intervals. The common framework for both these extensions and for integration on a finite interval is to (1) map the integration domain to \(t \in [0, \pi]\), (2) compute a Fourier sine or cosine approximation to the transformed integrand via interpolation, and (3) integrate the approximation. The interpolation is most easily performed via the sine or cosine cardinal functions, which are discussed in the appendix.

The algorithm is mathematically equivalent to expanding the integrand in (mapped or unmapped) Chebyshev polynomials as done by Clenshaw and Curtis, but the trigonometric approach simplifies the mechanics. Like Gaussian quadratures, the error for the change-of-coordinates Fourier method decreases exponentially with \(N\), the number of grid points, but the generalized Curtis-Clenshaw algorithm is much easier to program than Gaussian quadrature because the abscissas and weights are given by simple, explicit formulas.

MSC:
65D32 Numerical quadrature and cubature formulas
41A55 Approximate quadratures

Keywords:
Fourier approximation; infinite intervals; rational Chebyshev function; adaptive quadrature; Gaussian quadratures; Fourier method; Curtis-Clenshaw algorithm

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References:

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