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Fast Gauss-related quadrature for highly oscillatory integrals with logarithm and Cauchy-logarithmic type singularities. (English) Zbl 07455344

Summary: This paper presents an efficient method for the computation of two highly oscillatory integrals having logarithmic and Cauchy-logarithmic singularities. This approach first requires the transformation of the original oscillatory integrals into a sum of line integrals with semi-infinite intervals. Afterwards, the coefficients of the three-term recurrence relation that satisfy the orthogonal polynomial are obtained by using the method based on moments, where classical Laguerre and Gautschi’s logarithmic weight functions are employed. The algorithm reveals that with fixed \( n \), the method is capable of achieving significant figures within a short time. Furthermore, the approach yields higher accuracy as the frequency increases. The results of numerical experiments are given to substantiate our theoretical analysis.

MSC:
65D30 Numerical integration
65D32 Numerical quadrature and cubature formulas

Keywords:
highly oscillatory integrals; modified Chebyshev algorithm; steepest descent method; Cauchy principal value integrals; logarithmic weight function; algebraic and logarithm singular integrals

Software:
OPQ

Full Text: Link

References:

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