Nechuiviter O.P., Keita К.V., Кovalchuk A. G.

TWO-DIMENSIONAL INTEGRAL FROM HIGHLY OSCILLATING FUNCTIONS: IRREGULAR CASE

Nowadays digital signal processing and image is used in most problems of technical areas. Scientists have an issue of building new or improve known mathematical models, including mathematical models in digital signal processing and image containing new types of default information.

Today the problem should be solved in cases when the input information about function is a set of traces of function on planes or a set of traces of function on lines or as a set of values of the function in the points.

The research is expected to develop algorithms for computing integrals of highly oscillatory functions in general view

$$I(f,g,\omega)=\int_0^1\int_0^1 f(x,y)\sin\omega g(x,y)dxdy$$

in the multidimensional case using various information about functions. Theory of interlineations and interflatation of functions will be used during constructing optimal algorithms. This device is designed in Ukraine and has already proven to be able to provide new results not only in digital signal processing, but also in space, computer and seismic imaging, non-destructive testing.

Oscillatory integrals have various applications, but the problem is that it is difficult to compute them by standard methods. There is a number of papers, where problems of highly-oscillating functions are discussed for the regular case.

One and two-dimensional methods for computation of integrals of highly oscillating functions in irregular case are also discussed in various papers. In [1] were derived new methods for numerical approximating the integral of irregular highly oscillatory functions. In [2] was discussed calculation of canonical oscillatory integrals, and the irregular oscillatory integrals are transformed into canonical ones with respect to the presences of stationary phase points or not. Two calculation methods for the canonical oscillatory integrals are then proposed: one is the Clenshaw-Curtis method and the other is the improved-Levin method. In paper [3] authors have developed an adaptive Filon method for the computation of a highly oscillatory integral with or without stationary points. The main feature of this method is that it optimizes the choice of interpolation points between different oscillatory regimes.

The aim of this report is to show how we can effectively calculate two-dimensional integral from highly oscillating functions in more general case when the information about functions is a set of lines.

1. Olver, S.: Moment-free numerical integration of highly oscillatory functions. IMA J. Numer. Anal. 26, 213–227 (2006).

2. Liu Y. Fast Evaluation of Canonical Oscillatory Integrals. Appl. Math. Inf. Sci. 6, No. 2, 245-251 (2012).

3. Gao J. and A. Iserles, A. An Adaptive Filon Algorithm for Highly Oscillatory Integrals. Cambridge Numerical Analysis Reports (NA2016/05) / DAMPT. University of Cambridge. 30 p.

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