Multidimensional hypercomplex DFT: parallel approach

M.V. Aliev[1], M.A. Chicheva[2]
[1]Adygea State University
[2]Image Processing Systems Institute of RAS

Abstract:

The paper suggests a method for the parallel computation ofhypercomplex numbers in multidimensional space. In particular, a parallel algorithm for the computation of multidimensional hypercomplex discrete Fourier transform (HDFT) is proposed.

Keywords: DFT, hypercomplex numbers, multidimensional space, Fourier transform

Acknowledgments: This work was supported by the Russian-American program Basic Research and Higher Education (BRHE); and the Russian Foundation for Basic Research (RFBR), projects No. 03-01-00736, 05-01-96501.

Citation: Aliev MV, Chicheva MA. Multidimensional hypercomplex DFT: parallel approach. Computer Optics 2005; 27: 135-137.

Access full text (in Russian)

References:

[1] Aliev MV, Belov AM, Ershov AV, Chicheva MA. Algorithms of two-dimensional hypercomplex discrete Fourier transform [In Russian]. Computer Optics 2004; 26: 101-104.
[2] Furman YaA, Krevetsky AV, Peredreev AK. Introduction to contour analysis and its applications to image and signal processing [In Russian]. Moscow: "Fizmatlit" Publisher; 2002.
[3] Sommer G. Geometric computing with Clifford algebras. Berlin, Heidelberg: Springer-Verlag; 2001. ISBN: 978-3-540-41198-7.
[4] Vanwormhoudt MC. Rings of hypercomplex numbers for NT Fourier transforms. Signal Process 1998; 67(2): 189-198. DOI: 10.1016/S0165-1684(98)00036-X.
[5] Bülow T, Sommer G. Hypercomplex signals – A novel extension of the analytic signal to the multidimensional case. IEEE Trans Signal Process 2001; 49(11): 2844-2852. DOI: 10.1109/78.960432.
[6] Chaitelin F, Meškauskas T. Computation with hypercomplex numbers. Nonlinear Anal Theory Methods Appl 2001; 47(5): 3391-3400. DOI: 10.1016/S0362-546X(01)00454-0.
[7] Labunets EV, Labunets VG, Egiazarian K, Astola J. Hypercomplex moments application in invariant image recognition. Proceedings 1998 International Conference on Image Processing (ICIP98) 1998; 2: 257-261. DOI: 10.1109/ICIP.1998.723359.
[8] Sommer G. A geometric algebra approach to some problems of robot vision. In Book: Byrnes J, ed. Computational noncommutative algebra and applications. Dordrecht: Springer; 2004: 309-338. DOI: 10.1007/1-4020-2307-3_11.
[9] Aliev MV. Fast algorithms of d-dimensional DFT of real signal in commutative-associative algebras of 2D dimensionality over the real number field [In Russian]. Computer Optics 2002; 24: 130-136.
[10] Gupta A, Kumar V. The scalability of FFT on parallel computers. IEEE Trans Parallel Distrib Syst 1993; 4(8): 922-932. DOI: 10.1109/71.238626.
[11] Inda MA, Bisseling RH. A simple and efficient parallel FFT algorithm using the BSP model. Parallel Comput 2001; 27(14): 1847-1878. DOI: 10.1016/S0167-8191(01)00118-1.