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# EFFICIENT CALCULATION OF DIGITAL CONVOLUTION BASED ON FAST HARTLEY TRANSFORM

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**The paper describes an economic (from the computation cost viewpoint) algorithm for calculation of the cyclic digital convolution, and of the cross- and self-correlation functions of signals based on the fast Hartley transform. Application of the new algorithm makes it possible to diminish the computational complexity and the memory resource by one third as compared with the known version of the algorithm.**

One of the most widespread operations in digital processing of signals is calculation of the cyclic digital convolution of two functions $h(n)$ and $q(n)$ defined by expression

$$h(n) * q(n) = N^{-1} \sum_{m=0}^{N-1} h(n) q(n-m) \tag{1}$$

where "*" denotes convolution of two digital signals.

Many methods have been suggested for computations in conformity with formula (1), which differ in computational complexity or in the hardware implementation [1, 2]. The Hartley transformation (HT) [3] and its fast realization (FHT) [4, 5] offer certain advantages in calculation of digital convolution, since these procedures permit replacing the operations over complex numbers by operations over real ones in the most widely used method of convolution calculation based on the Fourier transform. Because of this, FHT has found wide utility in signal processing [6–10].

Particularly, it has been shown in [5, 9, 10] that calculation of the cyclic convolution can be performed with the aid of the Hartley transform in the frequency domain, i.e.,

$$h(n) * q(n) \Leftrightarrow H(k) Q_s(k) + H(N-k) Q_c(k) = Q(k) H_s(k) + Q(N-k) H_c(k) \tag{2}$$

where $H(k)$ and $Q(k)$ are the Hartley spectra taken of the functions $h(n)$ and $q(n)$, $n = 0, 1, 2, \ldots, N-1$, "$\Leftrightarrow$" denotes correspondence, and

$$H_s(k) = N^{-1} \sum_{n=0}^{N-1} h(n) \sin\left(\frac{2\pi nk}{N}\right), \tag{3}$$

$$H_c(k) = N^{-1} \sum_{n=0}^{N-1} h(n) \cos\left(\frac{2\pi nk}{N}\right), \tag{4}$$

$$Q_s(k) = N^{-1} \sum_{n=0}^{N-1} q(n) \sin\left(\frac{2\pi nk}{N}\right), \tag{5}$$

$$Q_c(k) = N^{-1} \sum_{n=0}^{N-1} q(n) \cos\left(\frac{2\pi nk}{N}\right). \tag{6}$$

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