# New Fast Algorithms
# for Signal Convolution and General Window Processing with Applications
# in Digital Holography and Image Processing

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Processing speed is a crucial issue in image and video processing because of the amount of data. Two complementing groups of processing algorithms are used that solve the problem of the computational complexity: (*i*) fast FFT type algorithms and (*ii*) recursive algorithms of processing in sliding window. However, these families of algorithms suffer from certain limitations. Available recursive algorithms are well developed only for windows with uniform weights, whereas in practical applications arbitrary window shapes and weights are required. FFT based algorithms, used for computing image convolution, analysis of periodicities and numerical reconstruction of holograms, suffer from heavy border effects caused by the cyclicity they impose on images. The present work is aimed at solving these problems and suggests a number of new algorithms that are virtually free of the above limitations. The following *new results* are presented:

- New methods of computation of image local statistics in weighted window of arbitrary shape and weights,
- A new DCT-based convolution algorithm, that is free of boundary effects, characteristic to the DFT-based convolution, and its applications for
    - Signal/ image scaling with arbitrary scaling factor $\sigma$ and
    - Image scaling & rotation by arbitrary scaling factor $\sigma$ and arbitrary rotation angle $\theta$,
    - Numerical reconstruction of holograms with simultaneous image scaling.

The algorithms are presented in detail, and their efficiency is experimentally verified.