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Representation of planar integral-transformations by 4-D wavelet decomposition

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In one way or the other numerical methods for the evaluation of integral operators can often be related to the solution of the so-called Galerkin equations. For convolution operators and exponentials with purely imaginary exponents as base function the Galerkin matrix becomes diagonal and this fact is the core of the FFT techniques, used in Physical Geodesy. For non-convolution operators the FFT technique is not applicable.
This paper aims at the development of a technique, which also can be applied for non-convolution operators. This technique is based on the use of wavelets as base functions. In this case the Galerkin matrix is not diagonal but (after thresholding) very sparse and this leads to methods, which are similarly efficient as FFT in the convolution case. The paper starts with the theoretical background for n-dimensional wavelet analysis and the representation of integral operators with respect to those wavelet bases. The resulting algorithm is tested for convolution and non-convolution operators.