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Short title: High accuracy representation of the free propagator.

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Review text:

The exponent of 1D Laplacean (interpreted as the free propagator of quantum mechanics) is given an approximate matrix (or rather algorithmic) form of an amendment of the well-known Fourier pseudospectral approximation where $O(N \log N)$ operations of the Fast Fourier Transform (FFT) “diagonalize” the operator. In the new method the fully discrete Fourier transforms are partially evaluated explicitly in terms of the error function. In the error analysis the accuracy of the two approximations are compared and the issues like stability and conservation are also considered. For linear and nonlinear Schrodinger equations a few numerical experiments are presented.