Double Preconditioning for Gabor Frames

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Abstract

We present an application of the general idea of preconditioning in the context of Gabor frames. While most (iterative) algorithms aim at a more or less costly exact numerical calculation of the dual Gabor atom, we propose here the use of "very cheap methods" to find an approximation of the inverse Gabor frame matrix, based on (double) preconditioning. We thereby obtain very good approximations of the true dual Gabor atom at very low computational costs. Since the Gabor frame matrix commutes with certain time-frequency shifts it is natural to make use of diagonal and circulant preconditioners sharing this property. Part of the efficiency of the proposed scheme results from the fact that all the matrices involved share a well-known block matrix structure. At least, for the smooth Gabor atoms typically used, the combination of these two preconditioners leads consistently to very good results. These claims are supported by numerical experiments in the second part of the paper. For numerical evaluations we introduce two new matrix norms, which can be calculated very efficiently by exploiting the structure of the frame matrix.

Index Terms

Block matrices; efficient algorithm; Gabor frame matrices; approximated dual windows; time-frequency analysis; operator norms; discrete transforms; matrix inversion; EDICS : 2-TIFR - Non-stationary Signals, Time-Frequency and Frequency-Frequency Analysis 2-FAST - Fast Algorithms, Transforms, and Computation