Superposition frames for adaptive time-frequency representations and fast reconstruction

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ABSTRACT: In this talk we introduce a broad family of adaptive, linear time-frequency representations termed superposition frames, and show that they admit desirable fast overlap-add reconstruction akin to standard short-time Fourier techniques. Our approach stands in contrast to existing adaptive time-frequency representations, which, despite their recognized importance for a broad range of signal processing applications, typically fail to provide for efficient reconstruction and often lack the structure necessary for precise frame-theoretic analysis. Though our construction is straightforward, proceeding via local signal-adaptive modification of a Gabor frame, we show it has nontrivial properties including a preservation of the original lower frame bound, a generalized constant overlap-add property that avoids explicit computation of dual windows and a means ofgenerating new families of adaptive lapped frames. Our primary algorithmic contributions come via the introduction and discussion of specific signal adaptation criteria in deterministic and stochastic settings, based on time-frequency concentration and nonstationarity detection, respectively. We conclude with examples that serves to highlight potential applications of our approach to audio signal processing.

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