

Bridging the gap between the short-time fourier transform (STFT), wavelets, the constant-Q transform and multi-resolution STFT

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Abstract-

The short-time Fourier transform (STFT) is extensively used to convert signals from the time-domain into the time-frequency domain. However, the standard STFT has the drawback of having a fixed window size. Recently, we proposed a variant of that transform which fixes the window size in the frequency domain (STFT-FD). In this paper, we revisit that formulation, showing its similarity to existing techniques. Firstly, the formulation is revisited from the point of view of the STFT and some improvements are proposed. Secondly, the continuous wavelet transform (CWT) equation is used to formulate the transform in the continuous time using wavelet theory and to discretize it. Thirdly, the constant-Q transform (CQT) is analyzed showing the similarities in the equations of both transforms, and the differences in terms of how the sweep is carried out are discussed. Fourthly, the analogies with multi-resolution STFT are analyzed. Finally, the representations of a period chirp and an electrocardiogram signal in the time-frequency domain and the time-scale domain are obtained and used to compare the different techniques. The analysis in this paper shows that the proposed transform can be expressed as a variant of STFT, and as an alternative discretization of the CWT. It could also be considered a variant of the CQT and a special case of multi-resolution STFT.

Index Terms- Wavelets, Short-Time Fourier Transform, constant-Q transform, time-frequency, time-scale, electrocardiogram.

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