Dynamic Time-Frequency Decompositions as Unique Fingerprints for Time Series Feature Extraction

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1 Abstract

This presentation will highlight research done on the use of wavelet transforms serving as unique fingerprints for time series data. Opening with a discussion of the challenges in time-frequency decompositions derived from the uncertainty principle [2] and laying out the motivations for a dynamic mesh resolution in the *transform space*.

The motivation for a dynamic decomposition leads into a discussion of audio data as time series, wavelet transform computation [1], and an overview of wavelet coherence analysis, including examples from other domains. The wavelet transform coefficients will be used to show the spectrograms of both recorded Irish music and synthetically generated tunes.

The talk will include a live demonstration of the capabilities of the wavelet coherence model by recording a tune and matching the wavelet transform up against a database of sheet music to, without deep learning or the internet, correctly identify the tune.

References

[1] Arts, L.P.A., van den Broek, E.L. The fast continuous wavelet transformation (fCWT) for real-time, high-quality, noise-resistant time–frequency analysis. Nat Comput Sci 2, 47–58 (2022). https://doi.org/10.1038/s43588-021-00183-z

[2] Gabor, D. "Theory of communication." Journal of the Institution of Electrical Engineers - Part III: Radio and Communication Engineering, 93(26), 429-457 (1946).