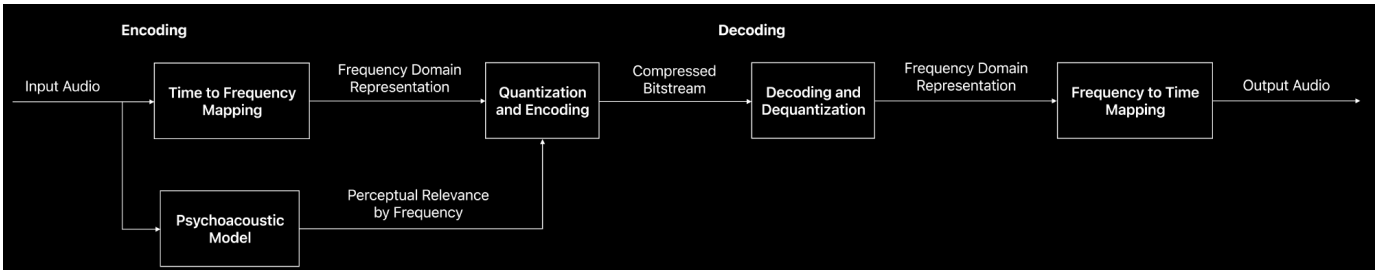
Docket #: S24-206

Adaptive Extended TDAC Audio Processing System for Improved Coding Efficiency

Researchers at Stanford have developed an adaptive audio filter bank system that aims to improve the efficiency and quality of perceptual audio coding by analyzing and synthesizing audio more precisely and dynamically adapting to the audio signal characteristics.

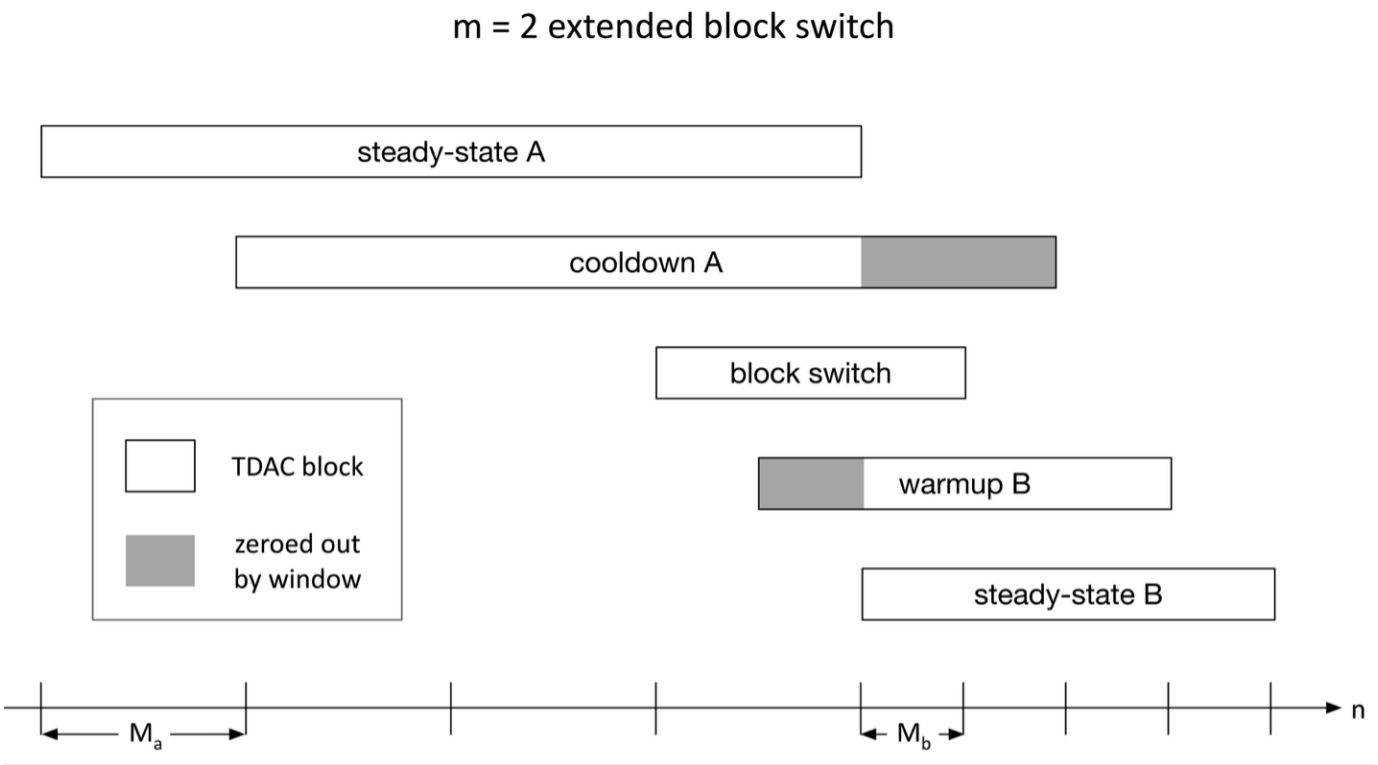
Modern digital audio systems rely on perceptual audio codecs to efficiently store and transmit high-quality audio. These codecs use filter banks to convert audio from the time domain to the frequency domain for data compression. Time-domain aliasing cancellation (TDAC) transforms are a widely used filter bank approach, but their frequency and time resolution can be limited. Attempts to improve frequency resolution have affected how flexibly and rapidly they can traverse the time–frequency resolution trade-off. Both filterbank resolution and rapid time-frequency adaptivity are essential heuristics for audio coding quality.



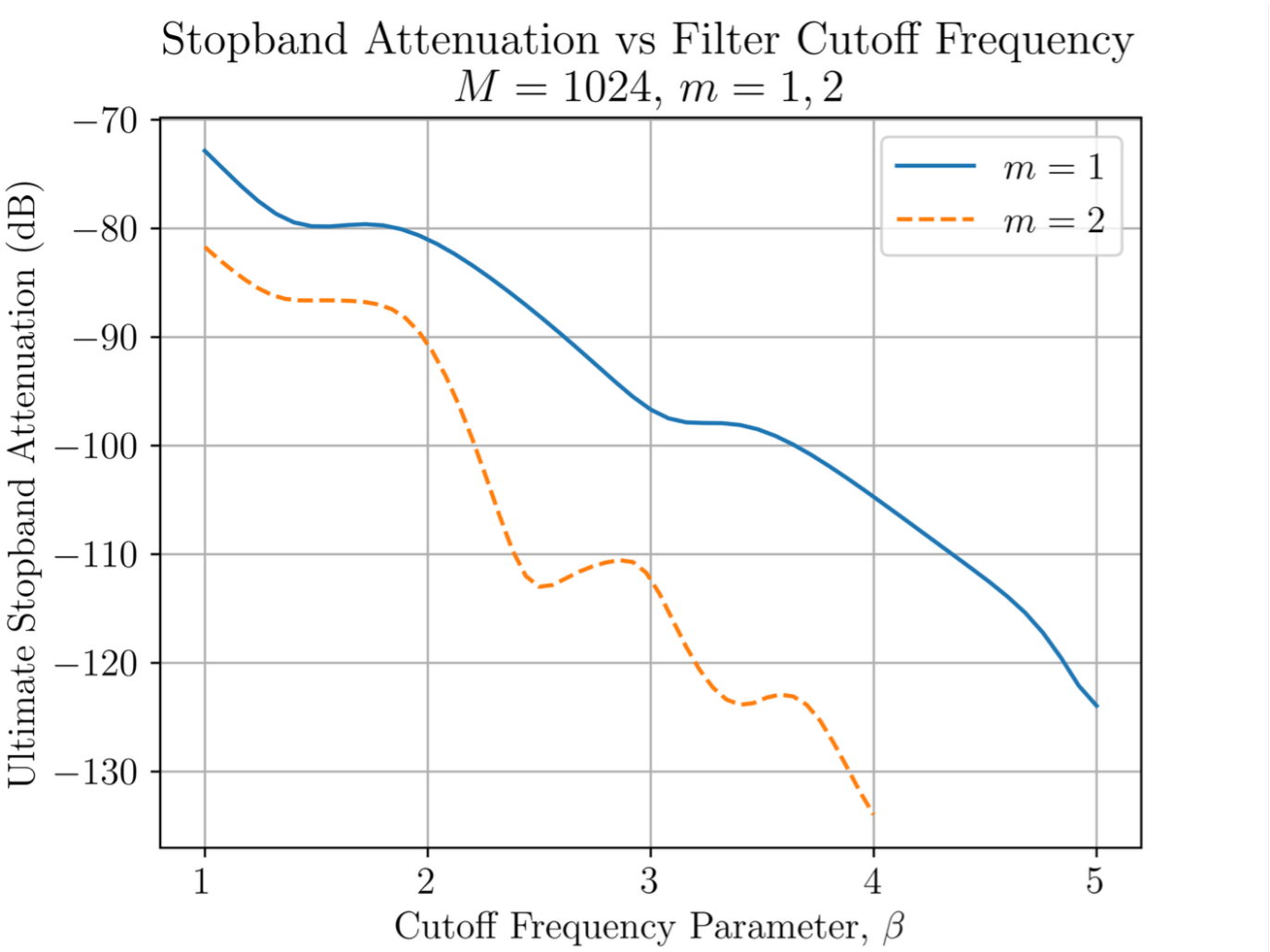
Perceptual Audio Coding Schematic (Image courtesy Ryan Wixen and Marina Bosi)

This system introduces an adaptive extended TDAC transform that dynamically switches between different transform configurations based on the characteristics of the input audio. Optimized extended windows enhance the transform's stopband attenuation, and the audio coder transitions rapidly and without distortion between

configurations.. The result is the potential for superior coding quality across a wider range of audio content, with applications in music streaming, broadcast audio, and telecommunications.



Example transition between two extended transform configurations, showing how the system seamlessly switches from one hop size to another. (Image courtesy Ryan Wixen and Marina Bosi)



Proof of Concept Prototype Filter Stopband Attenuation vs Filter Cutoff Frequency
Prototype filters optimized for minimum stopband energy achieve greater stopband attenuations with greater cutoff frequencies, and The extended transforms (m=2) achieves 10 to 25 dB greater stopband attenuation than a conventional non-extended transforms (m=1) across all cutoff frequencies. (Image courtesy Ryan Wixen and Marina Bosi)

Stage of Development - Proof of concept

Applications

- **Audio streaming** and compression codecs for consumer and professional applications including audiovisual storage and transmission
- **Broadcast and telecommunications audio** encoding systems

- **Audio encoding** hardware and software tools

Advantages

- **More efficient compression** by dynamically matching transform resolution to signal type with improved filter stopband attenuation
- **Flexible, rapid, distortionless transitions** between transform configurations
- **Efficient** implementation with reduced memory requirement
- **Compatible** with fast computational algorithms, various MPEG audio coding, and proprietary (Dolby AC-3, EAC-3, AC-4) audio coding for low-complexity implementation
- **Applicable to both encoder and decoder** components in standard codec architectures

Publications

- Wixen, R., & Bosi, M. (2026). Adaptive Extended ETDAC Transforms Using Discrete Trigonometric Transforms.. *IEEE Signal Processing Letters,* 33, 3856–3860. https://doi.org/10.1109/LSP.2026.3733000

Patents

- Published Application: 20250356865

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