Multiresolution STFT Phase Estimation with Frame-Wise Posterior Window Length Decision

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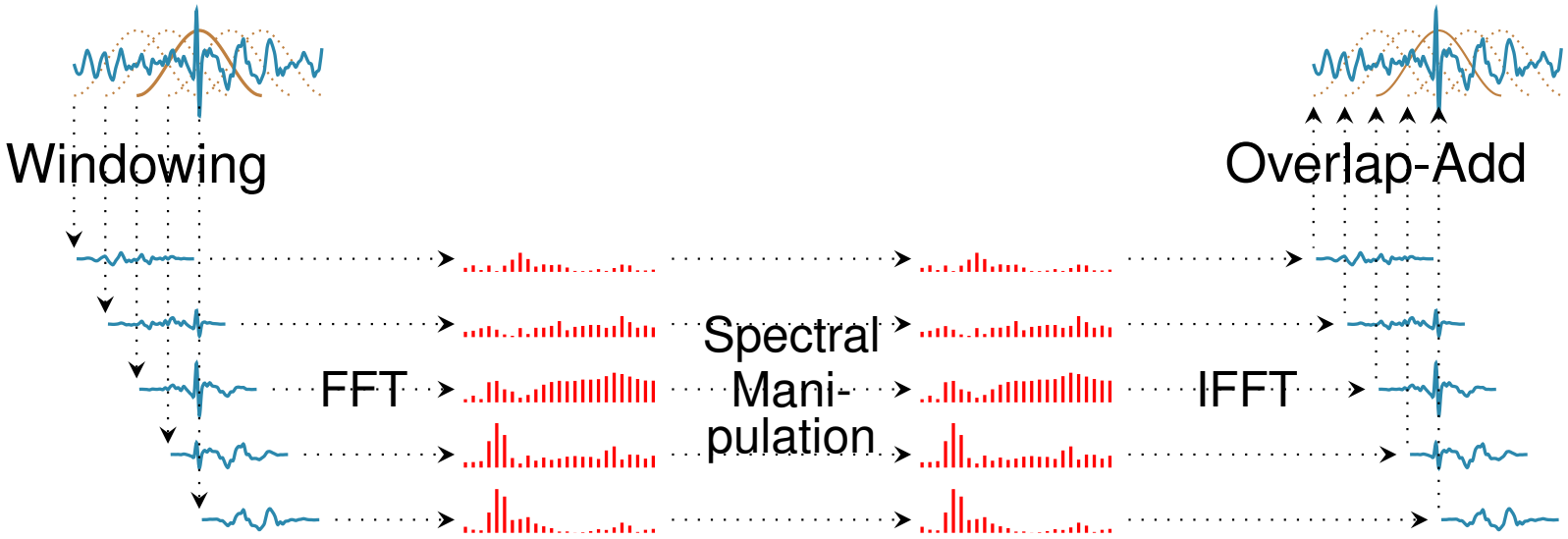
Overview

- Motivation
- RTISI Phase Estimation
- Parallel Multi-Resolution RTISI Phase Estimation
- Posterior Minimax Decision
- Experiments and Results

Motivation: What Is Phase Estimation Good For?

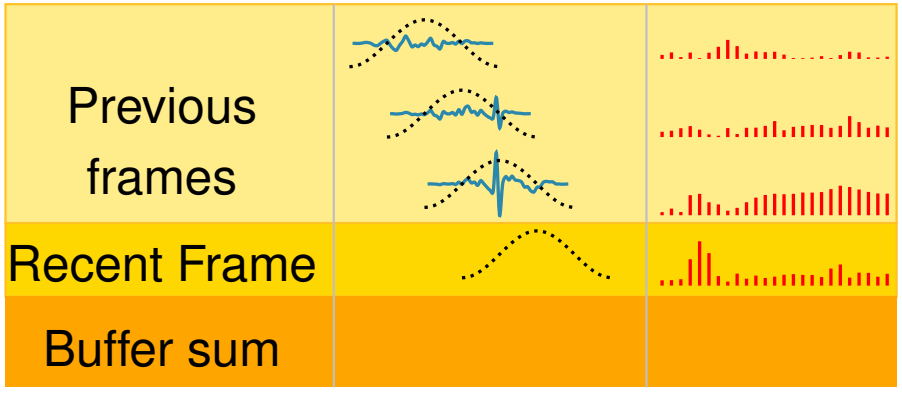


FFT Coefficients are complex

- $C = |C| \cdot e^{j\varphi}$ mit $|C|$ = Magnitude, φ = Phase
- Magnitude **and** phase are required for reconstruction: ♫, ♫
- In many applications no (or just an approximate) phase is available.

RTISI Phase Estimation

RTISI = Real-Time Iterative Spectrogram Inversion (Zhu, Beauregard, Wyse, IEEE ASLP, 2007)



- Consecutive frames are stored in consecutive rows.
- Every row stores:
  - recent time-domain signal estimation
  - magnitude spectrum

Initialization

- neutral: zeros
- better: phase unwrapping

Basis algorithm

- Combination of
  - recent magnitude spectrum
  - phase spectrum of the buffer sum
- Result → time domain
- Window, store back

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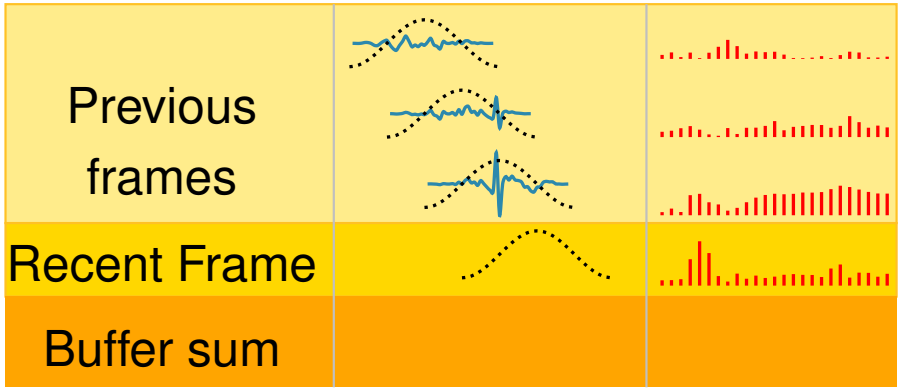

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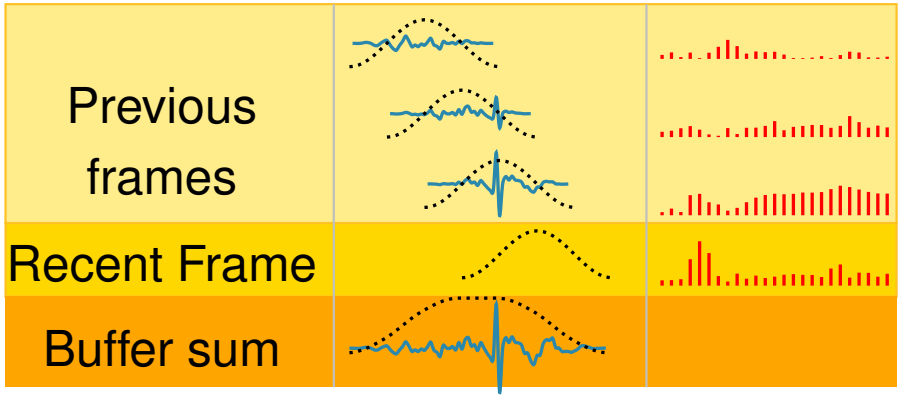

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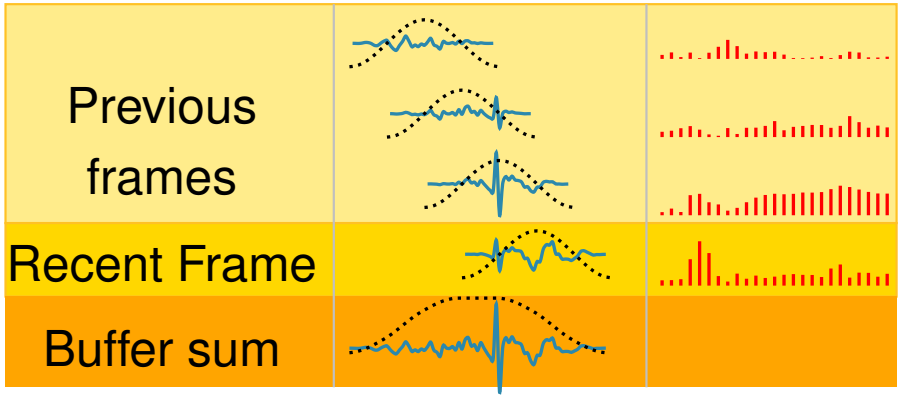

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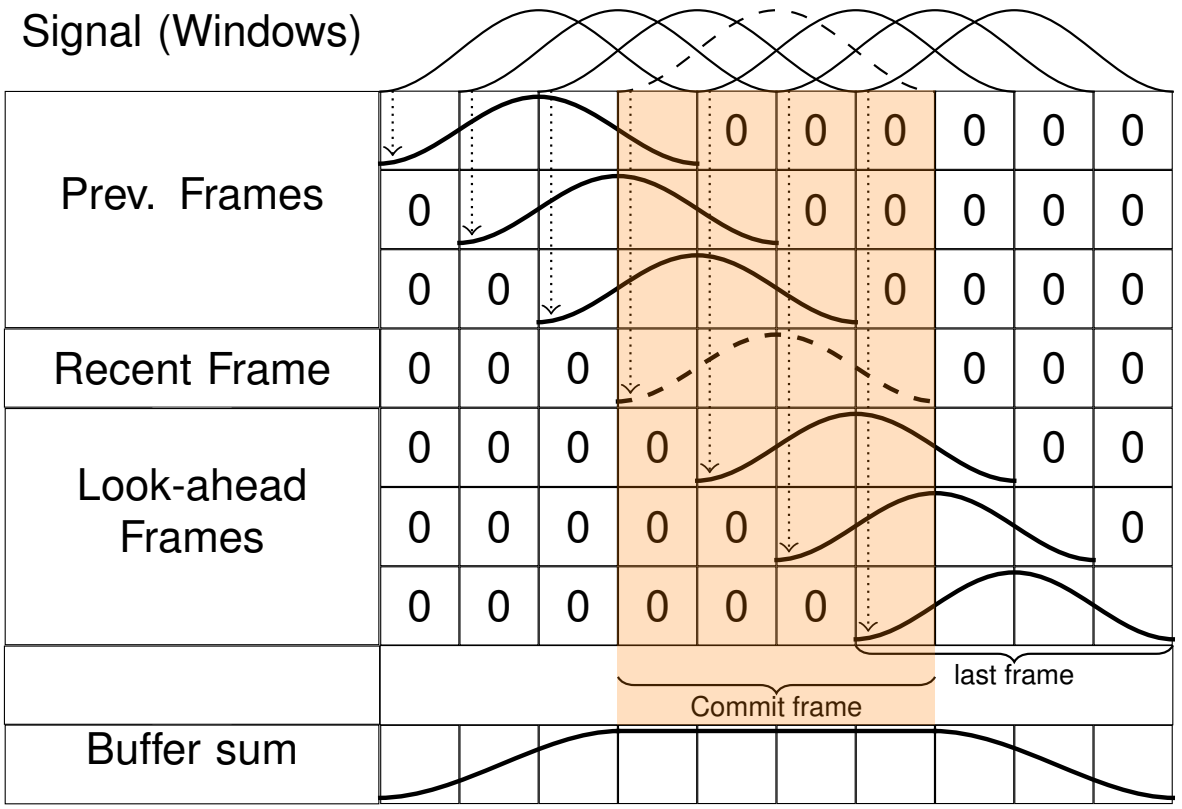
RTISI with Look-Ahead



Order

- **Standard:** first the last frame, then second-last, ...
- **Improvement:** first loudest frame, then second-loudest, ...
- one iteration after another.

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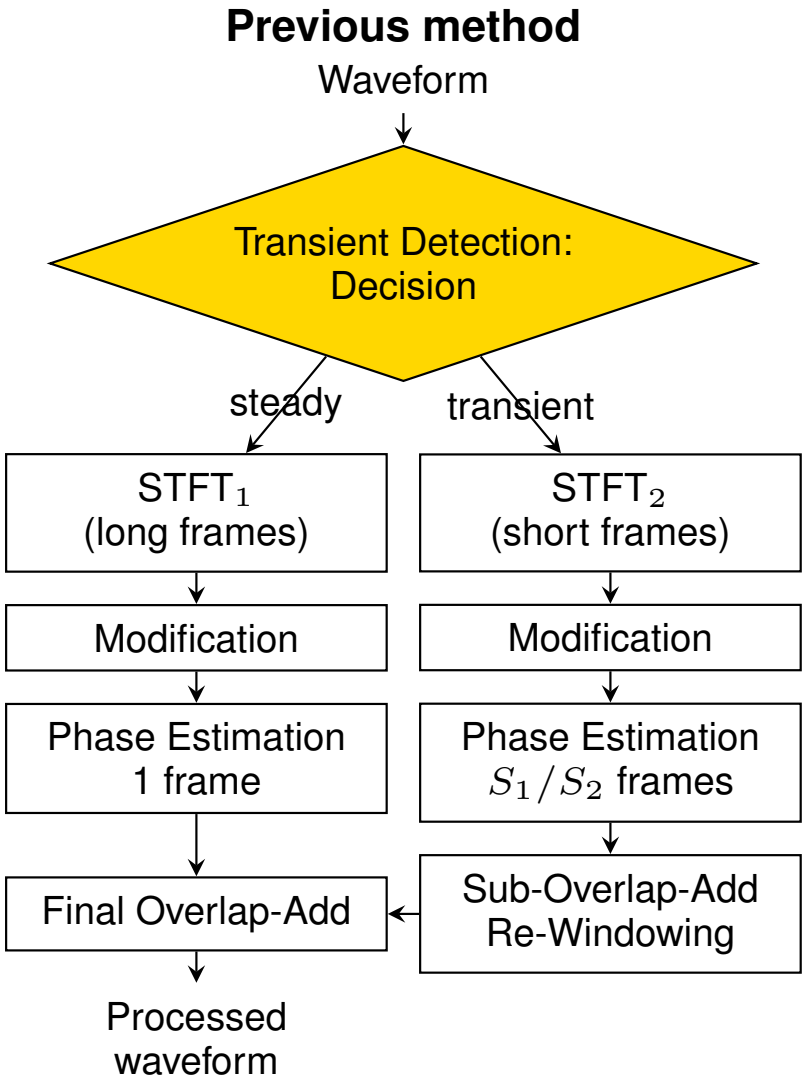
Parallel Multiresolution Processing (I)



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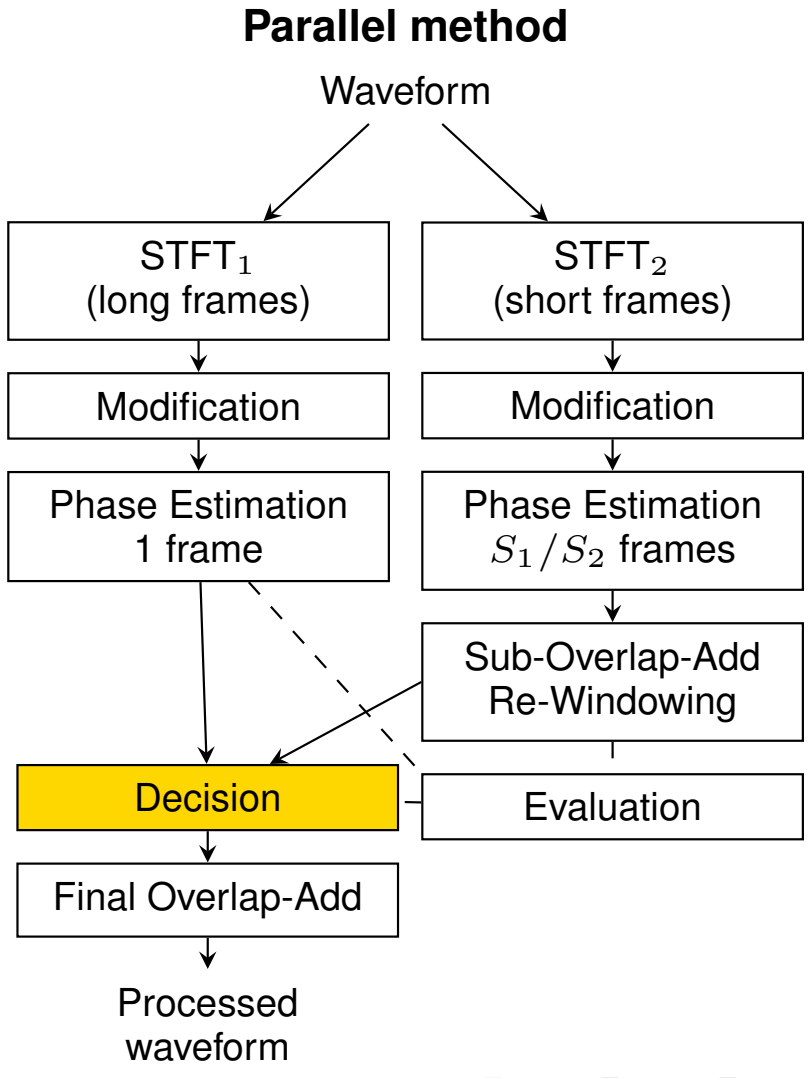

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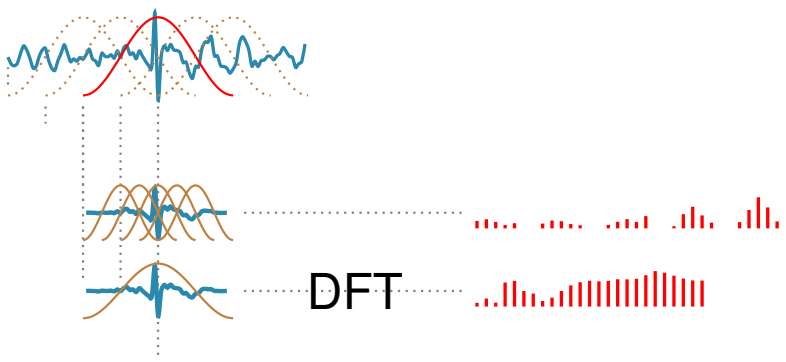
Parallel Multiresolution Processing (II)



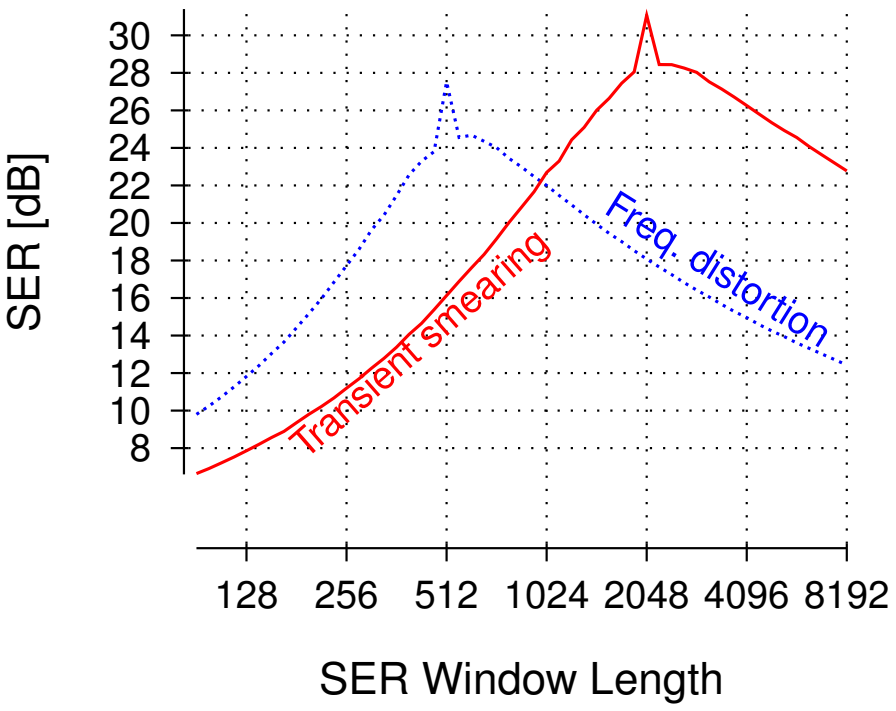
Properties

- Standard window: Hamming
- Parallel generation of long-w.len **spectrum** and short-w.len **spectrogram**

Advantages of parallel processing

- Decision is made when phase estimation is known.
  - No previous transient detection needed.
  - Better decisions can be expected.
- Modification algorithms know **the whole** magnitude spectrogram.
- Extension to more than two buffers straightforward.

Minimax Decision



Listening Examples

- Frequency distortion: ♫
- Transient smearing: ♫

Minimax Assumption

- The lower the SER, the better audible the error (the worse the result.)
- Choose phase estimation which maximizes the lowest SER. → Decide which error is the lesser evil.

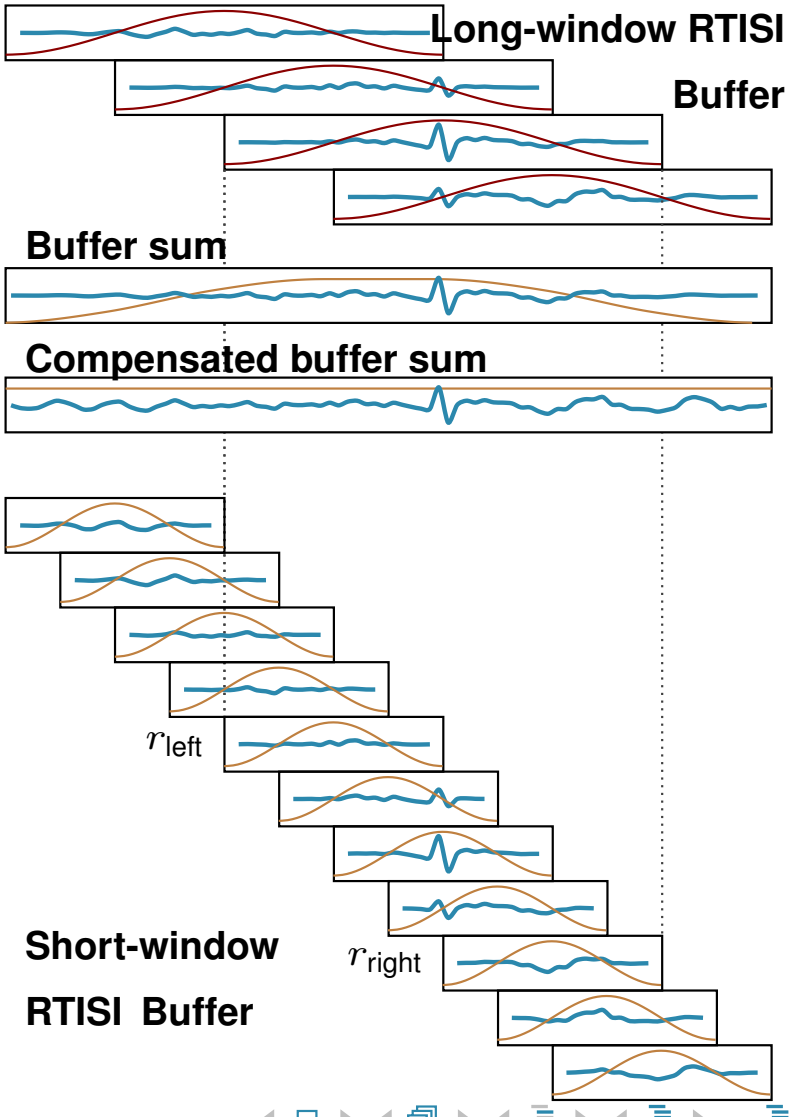
Synchronization between RTISI buffers

Long and short blocks

- Standard RTISI

Synchronization

- Get source buffer sum.
- Compensate for the window sum.
- Fill target buffer with windowed sum segments.



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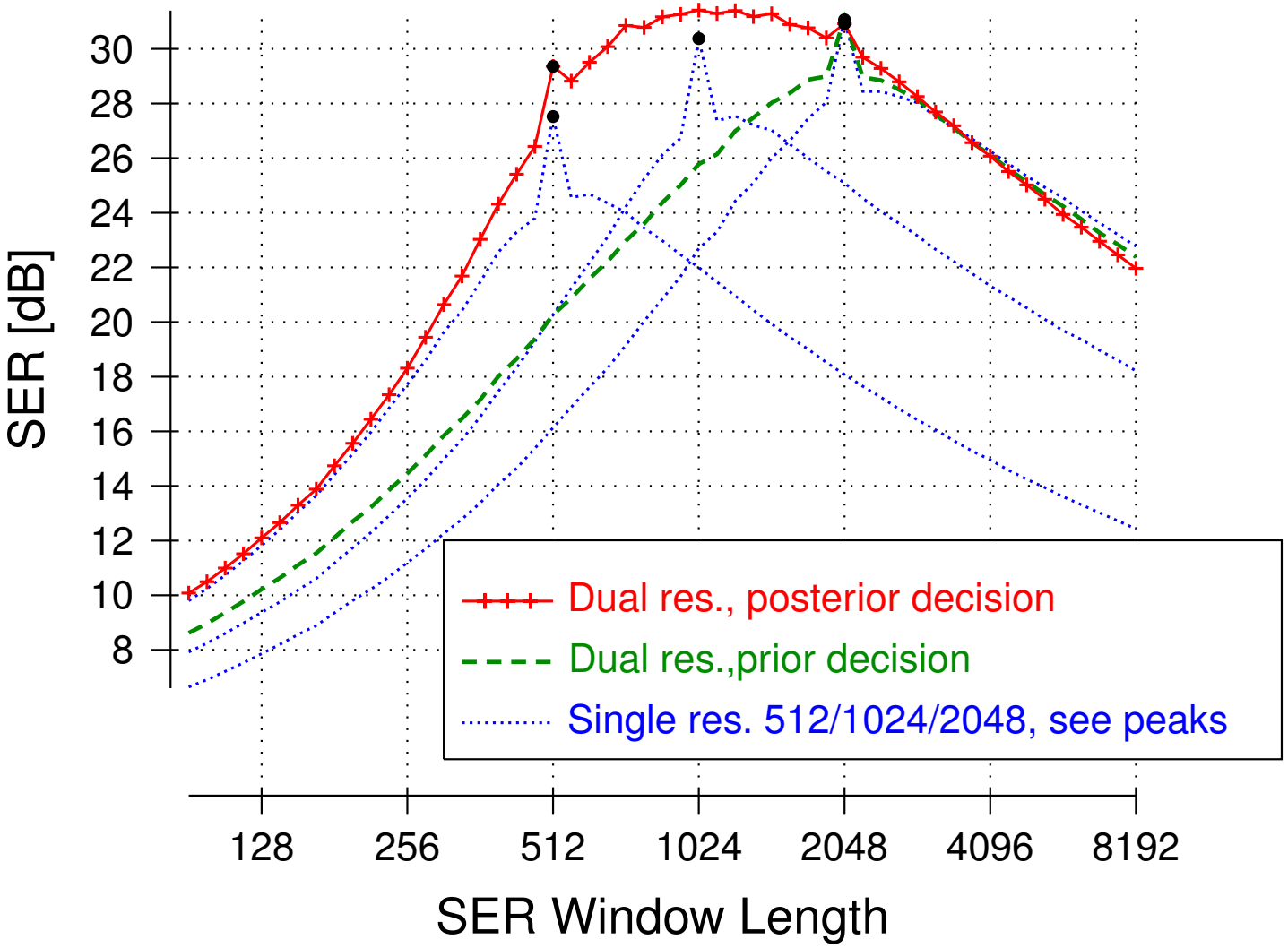
Experiments and Results (I)



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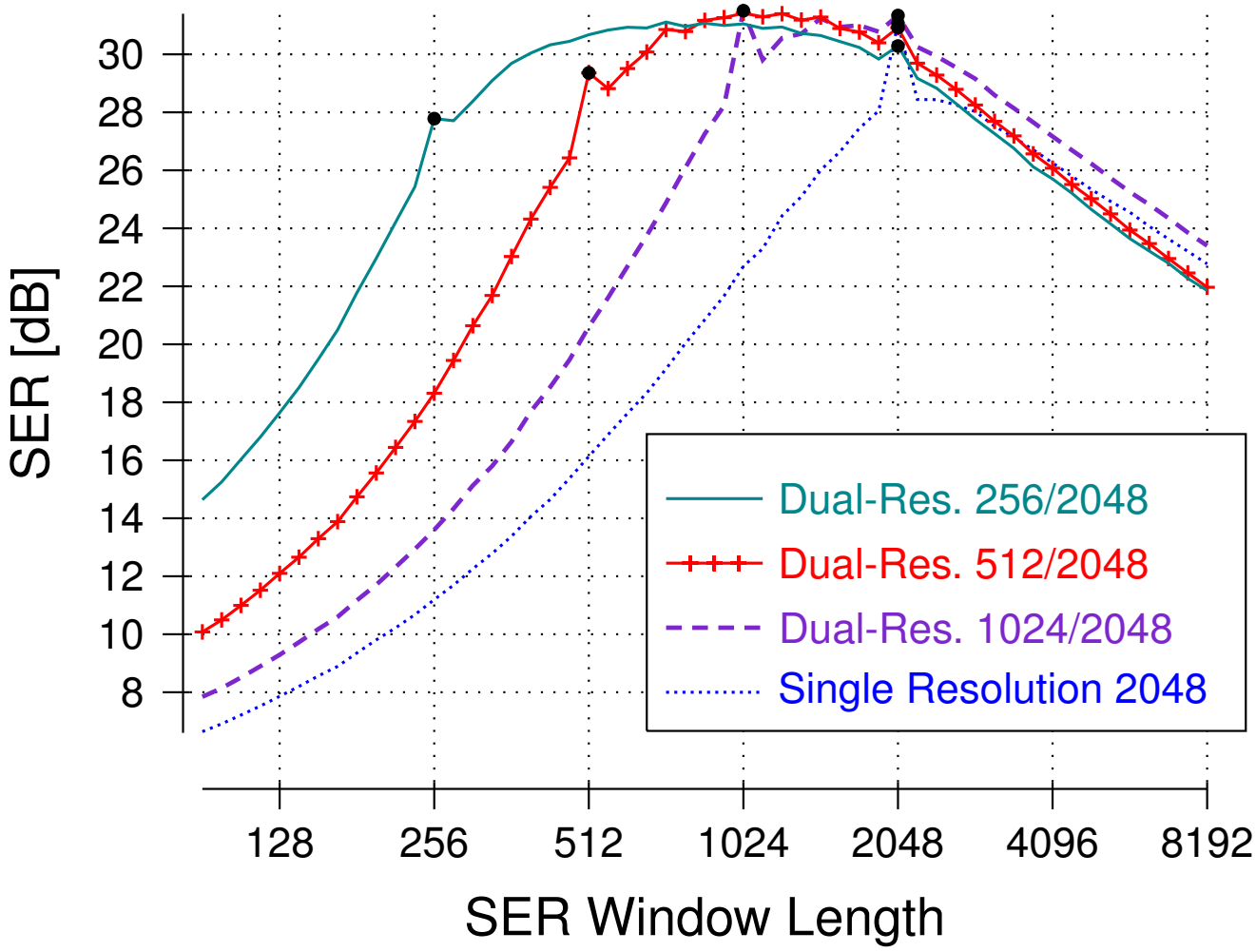
Experiments and Results (II)



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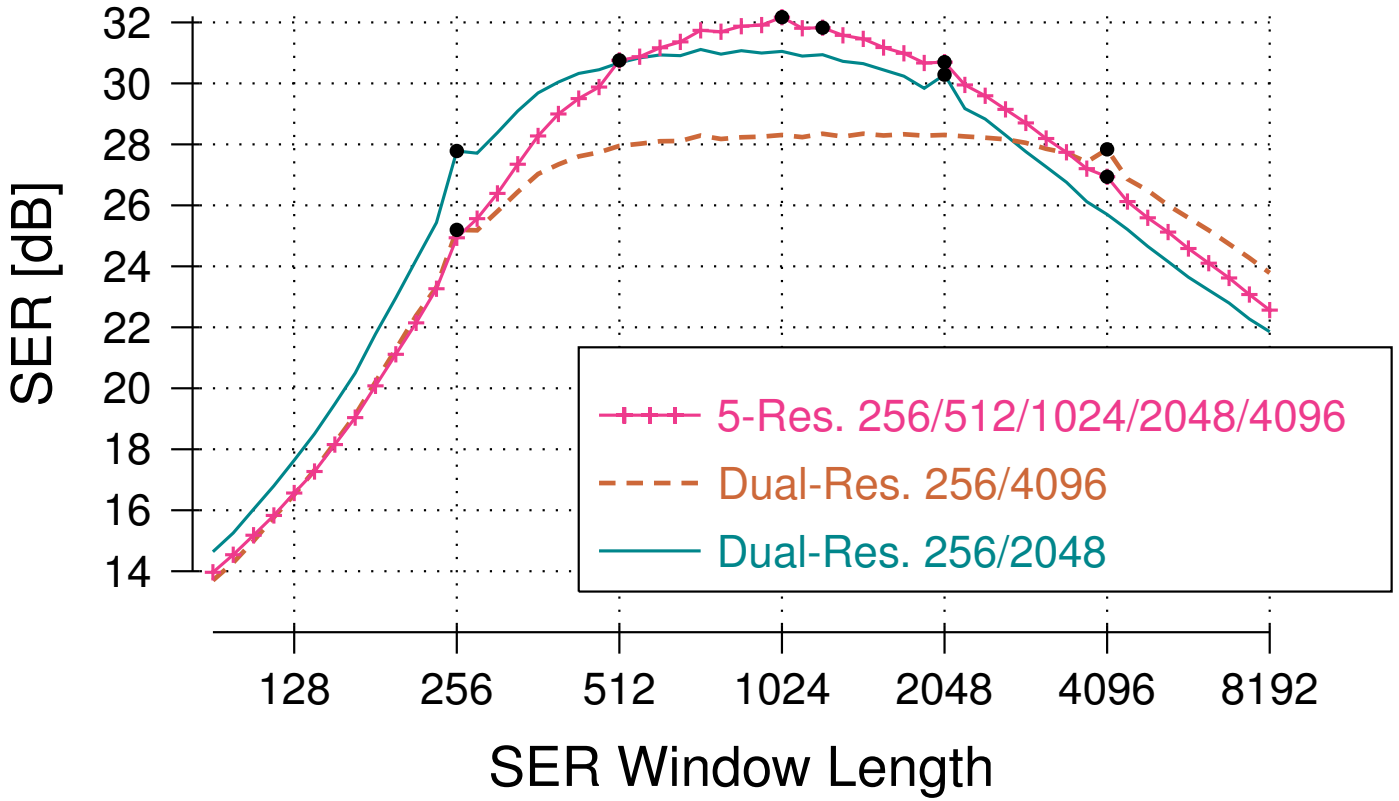
Experiments and Results (III): Multiresolution



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Listening Examples

- Original: ♫
- Single resolution:
  - 512 Samples: ♫
  - 1024 Samples: ♫
  - 4096 Samples: ♫
- Dual-Resolution 512/4096:
  - A-priori estimation: ♫
  - A-posteriori estimation: ♫
- Multiresolution 512/1024/2048/4096 ♫:

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Thank you for your attention!