

# PRE-ECHO NOISE REDUCTION IN FREQUENCY-DOMAIN AUDIO CODECS

Jimmy Lapierre and Roch Lefebvre

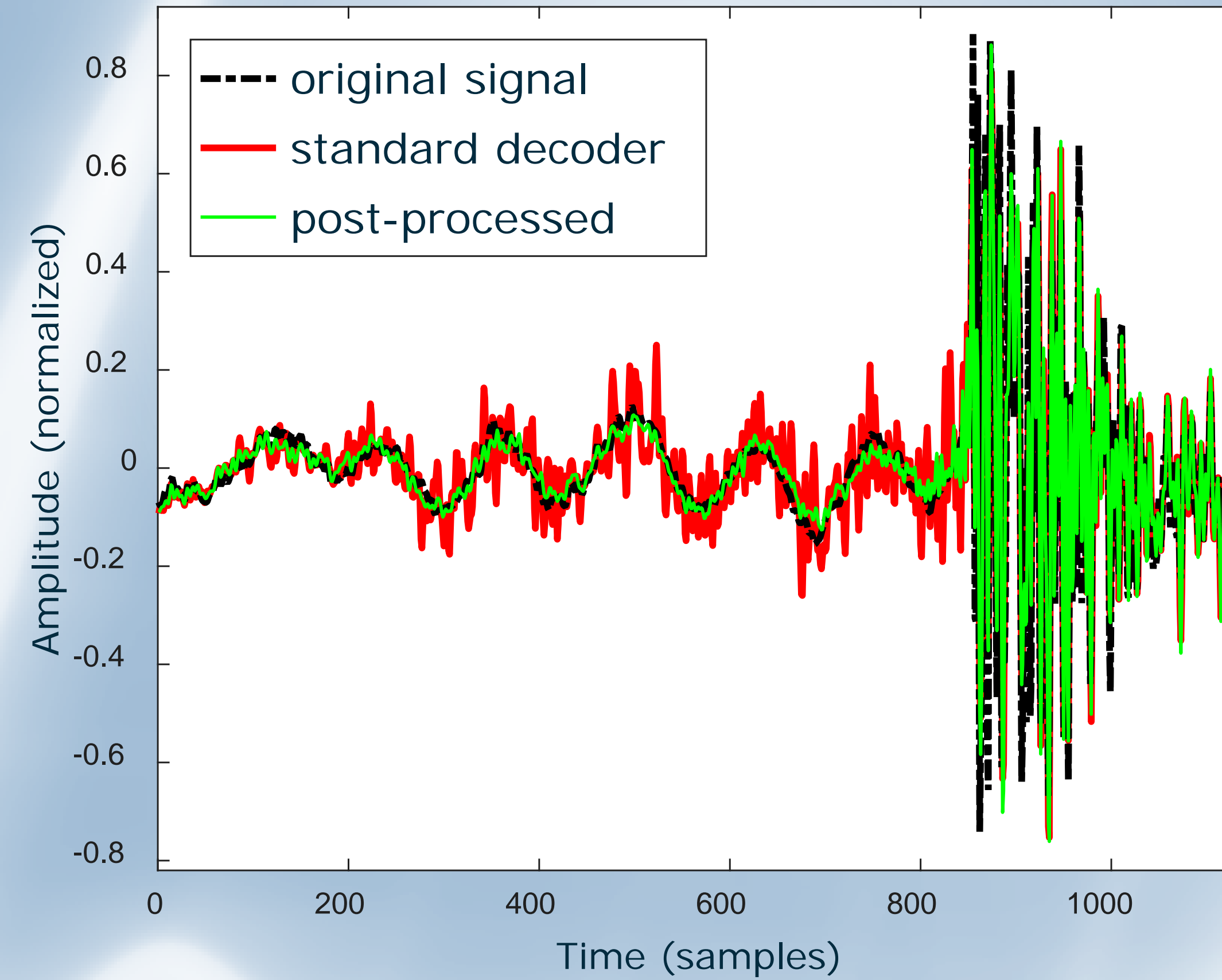
Jimmy.Lapierre@USherbrooke.ca

Université de Sherbrooke, QC, Canada

## INTRODUCTION

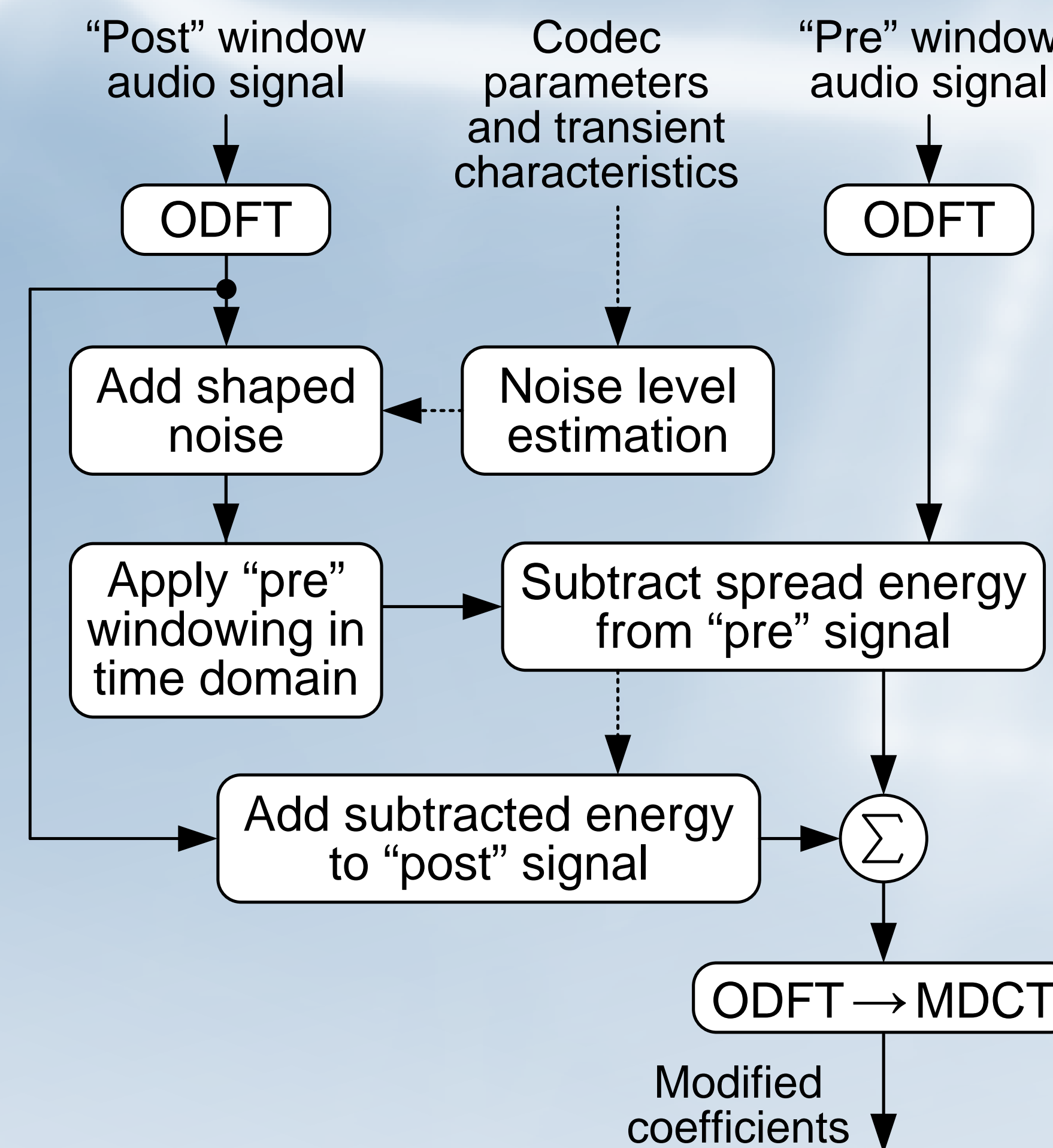
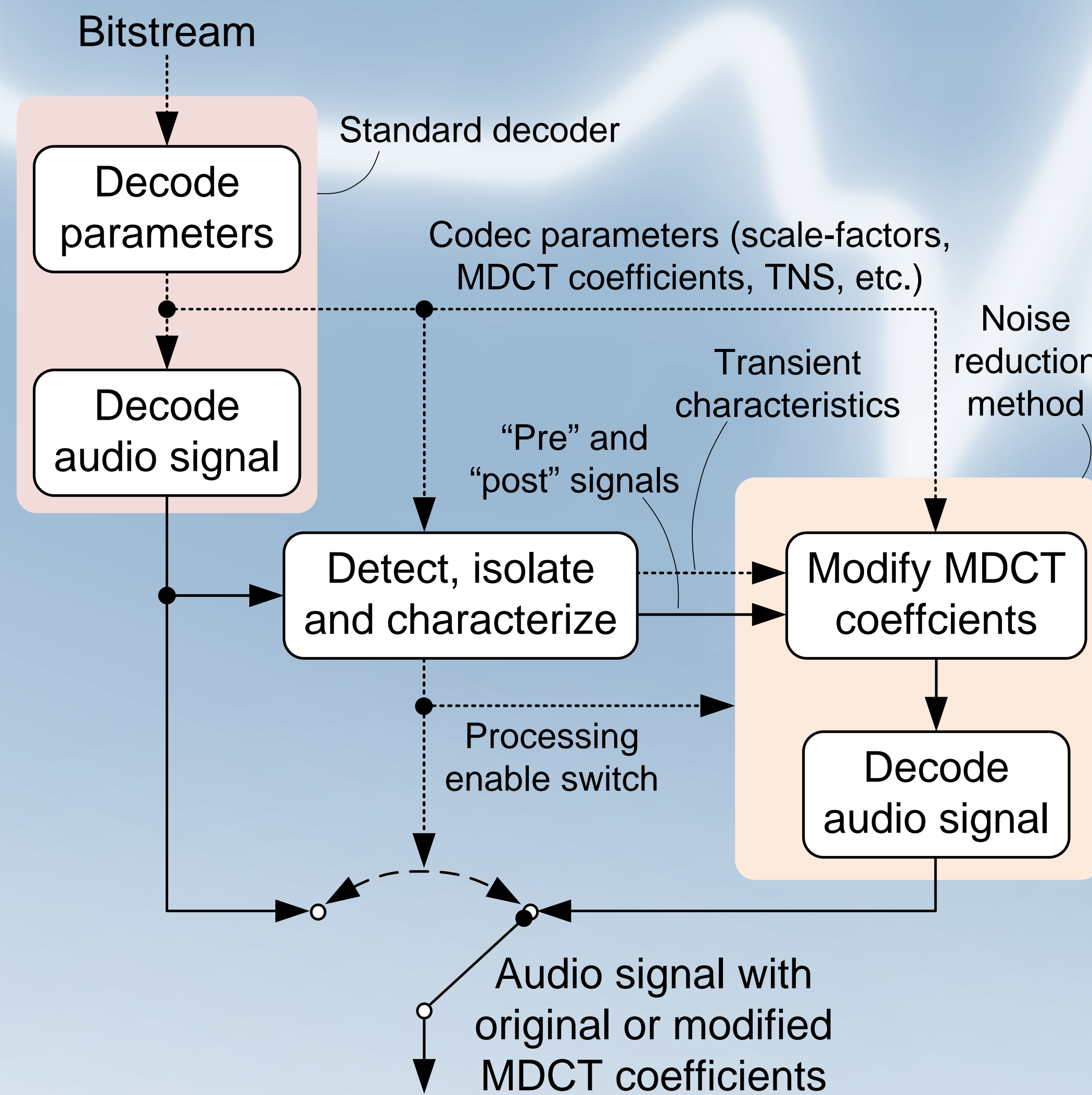
- **Pre-echo noise** is one of the **most common yet detrimental** artefacts in frequency-domain audio coders such as **MPEG AAC**, it is discernable even without direct comparison to the original signal.
- Current pre-echo noise reduction techniques **reduce efficiency**, either by transmitting extra bits to describe the transient (e.g. TNS) or by using less efficient short blocks to minimize the problem.
- We developed a method that **makes better use of readily available information** at the decoder to **accurately model the noise spread** caused by transient signal quantization and **significantly reduce it**.
- The method **applies to existent standards** and **does not reduce coding efficiency**, as the encoder does not require any modifications.

Pre-Echo Noise Reduction Effect



## ALGORITHM

- The **likelihood of each frame** to produce pre-echo noise determines if it is processed. This decision is based on **transient characteristics** that are measured and reused by the noise reduction method.
- Processed frames are first **split** into two parts, i.e. the **pre-transient** and **post-transient** parts.
- The pre-transient noise produced by the quantization of the energetic transient signal is **characterized** using decoded **codec parameters**, **transient features** and MDCT/ODFT **transform properties**.
- This precise frequency-domain noise estimate allows spectral subtraction to remove pre-echo noise in the pre- signal without adding any artefacts.
- Total frame energy is preserved by spectral addition to the post- signal.



## RESULTS

- Formal **subjective** testing using the **MUSHRA** methodology shows an average gain of **2 points** for MPEG AAC at 24 and 28 kbps.
- **Objective SNR** testing produced an average gain between 0.22 and 0.45 dB for MPEG AAC processed frames encoded between 12-32 kbps.

## CONCLUSION

- A **novel** algorithm has been proposed to reduce pre-echo noise, requiring **no encoder alterations** and **no reduction of coding efficiency**. Therefore, it is compatible with encoders that are already deployed.
- The coefficient modifications are small and limited to their quantization intervals: there is **little or no risk of introducing new artefacts**.
- **Both subjective and objective quality is improved**, demonstrating that the processed signal is noticeably enhanced and that underexploited valuable information was recovered from the bitstream.