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# A Real-time Equalizer of Harmonic and Percussive Components in Music Signals

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## ABSTRACT

Goal:

A real-time equalizer to control a volume balance of harmonic and percussive components in music signals without a priori knowledge of the scores or the included instruments.

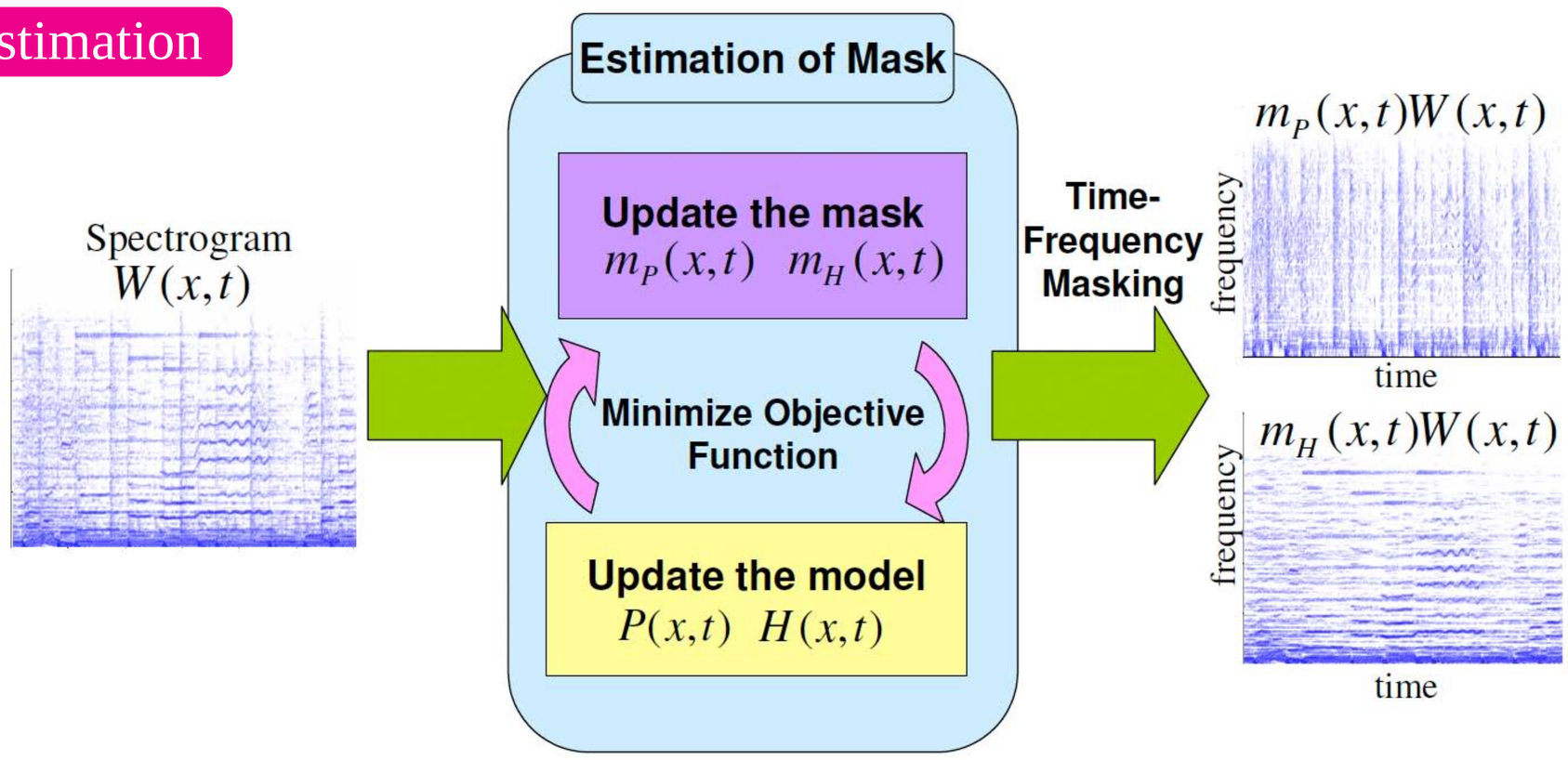
Method:

The harmonic and percussive components of music signals have much different structures in the power spectrogram domain, the former is horizontal, while the latter is vertical.

Exploiting the anisotropy, our methods separate input music signals into them based on the MAP estimation framework.

## Our Approaches

### The MAP estimation




The objective function to minimize iteratively can be written as...

in method1: I-divergence-based mixing model

$$
\begin{aligned}
& J_1(\boldsymbol{H},\boldsymbol{P}) \\
&= -\sum_{h,i}\left\{W_{h,i}\log\frac{W_{h,i}}{H_{h,i}+P_{h,i}} - W_{h,i} + H_{h,i} + P_{h,i}\right\} \\
&\quad -\frac{1}{\sigma_H^2}(\sqrt{H_{h,i-1}} - \sqrt{H_{h,i}})^2 \\
&\quad -\frac{1}{\sigma_P^2}(\sqrt{P_{h-1,i}} - \sqrt{P_{h,i}})^2)
\end{aligned}
$$

in meethod 2: hard mixing model

$$
\begin{aligned}
J_2(\hat{\boldsymbol{H}},\hat{\boldsymbol{P}}) &= -\frac{1}{2\sigma_H^2}\sum_{h,i}(\hat{H}_{h,i-1} - \hat{H}_{h,i})^2 \\
&\quad -\frac{1}{2\sigma_P^2}\sum_{h,i}(\hat{P}_{h-1,i} - \hat{P}_{h,i})^2
\end{aligned}
$$

Each function has terms related to the smoothness of spectrogram.

### Sliding Block Analysis

In order to obtain an approximate solution in real-time, we propose a slidingupdate algorithm. We limit the processed frames size of the analysis block, and slide it iteratively as follows.

1. Set the new frame from waveform by STFT.
2. Update each variables.
3. Convert the last frame of the analysis block to a waveform by the inverse-STFT.
4. Slide the analysis block.