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The PEASS Toolkit - Perceptual Evaluation methods for Audio Source Separation

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THE PEASS TOOLKIT: overview

A toolkit for the perceptual evaluation of audio source separation
- The PEASS Software: a set of objective measures to predict the perceptual quality of the source/image estimates
- The PEASS Listening Test GUI: a Matlab MUSHRA GUI realized for the proposed test protocol
- The PEASS Subjective Database: a set of subjective measures resulting from listening tests (20 subjects × 80 sounds × 4 rating criteria)

The PEASS Toolkit is freely available at [http://bass-db.george.inria.fr/peass/](http://bass-db.george.inria.fr/peass/)


MOTIVATION: the need for a multi-criteria perceptually-based evaluation

Existing model for distortion decomposition [3]

\[ s_j(t) = s_j^\text{target}(t) + s_j^\text{interf}(t) + s_j^\text{artif}(t) \]  

- \( s_j^\text{target} \) denotes the error component related to the target distortion,
- \( s_j^\text{interf} \) denotes the interference from concurrent sources,
- \( s_j^\text{artif} \) is the remaining distortion component (artifacts and noise).

Defining and estimating the distortion components \( s_j^\text{target} \), \( s_j^\text{interf} \), \( s_j^\text{artif} \) is not trivial. Due to the allowed distortions in use today (time-invariant spatial and filtering distortions), the decomposition is not satisfying.

Existing quality measures: energy ratios SDR, ISR, SIR, SAR are poorly correlated with subjective scores.

Proposed multi-criteria listening test protocol

A series of 4 MUSHRA tests including several dedicated anchors:

(1) Rate the global quality compared to the reference.
(2) Rate the quality in terms of preservation of the target source.
(3) Rate the quality in terms of suppression of other sources.
(4) Rate the quality in terms of absence of additional artificial noise.

PROPOSED OBJECTIVE MEASURES: what’s new?

A better distortion decomposition is achieved by:
- splitting the signals into subbands using gammatone filters;
- segmenting each subband signal into overlapping frames;
- decomposing each frame into distortion components using a matched FIR filter;
- reconstructing the full distortion components.

Some auditory-motivated features are derived using PEMO-Q/PSM [4]:

\[ q_j^\text{overall} = \alpha \text{PEMO-Q}(s_j) \]
\[ q_j^\text{target} = \alpha \text{PSM}(s_j, s_j^\text{target}) \]
\[ q_j^\text{interf} = \alpha \text{PSM}(s_j, s_j^\text{interf}) \]
\[ q_j^\text{artif} = \alpha \text{PSM}(s_j, s_j^\text{artif}) \]

By combining the 4 features in a non-linear way to predict subjective scores \( T_j \) (\( j = 1 \)), a set of objective measures is finally output:

- OPS: the Overall Perceptual Score,
- TPS: the Target-related Perceptual Score,
- IPS: the Interference-related Perceptual Score,
- APS: the Artifacts-related Perceptual Score.

EVALUATION RESULTS: prediction performance and evaluation at SiSEC 2010

Prediction results (cross-validation on the PEASS database) for the 4 tasks: curves are various combinations of the old/new decompositions with the energy ratio/PEMO-Q measures, as a function of the number of features.

Accuracy = 0.23; Monotonicity = 0.21;

Accuracy = 0.29; Monotonicity = 0.31;

Accuracy = 0.34; Monotonicity = 0.4;

Accuracy = 0.16; Monotonicity = 0.34;