



**HAL**  
open science

# The PEASS Toolkit - Perceptual Evaluation methods for Audio Source Separation

Valentin Emiya, Emmanuel Vincent, Niklas Harlander, Volker Hohmann

► **To cite this version:**

Valentin Emiya, Emmanuel Vincent, Niklas Harlander, Volker Hohmann. The PEASS Toolkit - Perceptual Evaluation methods for Audio Source Separation. 9th Int. Conf. on Latent Variable Analysis and Signal Separation, Sep 2010, Saint-Malo, France. 2010. inria-00545477

**HAL Id: inria-00545477**

**<https://inria.hal.science/inria-00545477v1>**

Submitted on 7 Dec 2011

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

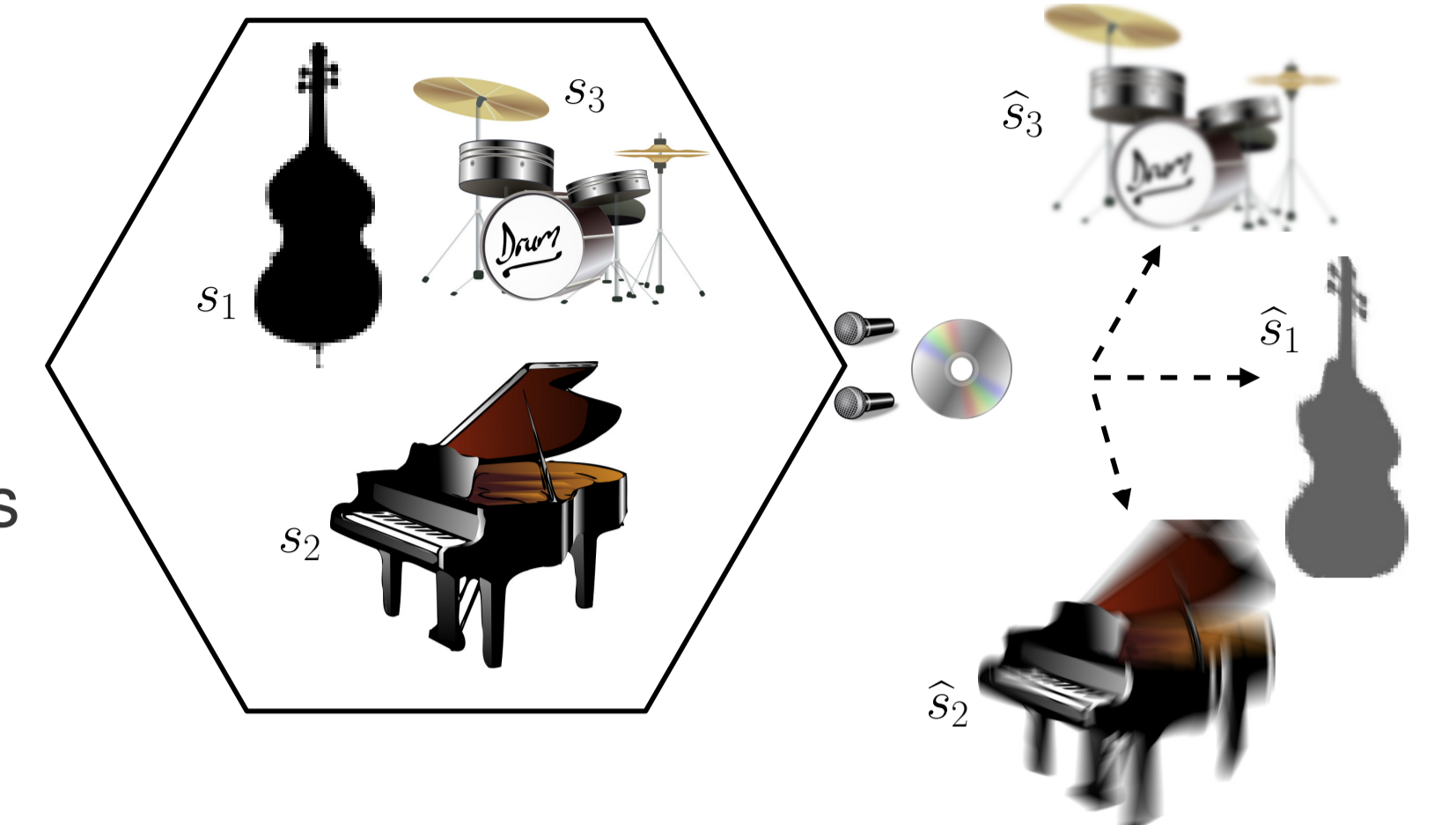
# The PEASS Toolkit - Perceptual Evaluation methods for Audio Source Separation

Valentin EMIYA, Emmanuel VINCENT • METISS, INRIA Rennes - Bretagne Atlantique (France)  
Niklas HARLANDER, Volker HOHMANN • Carl von Ossietzky Universität Oldenburg (Germany)

## 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  $\times$  80 sounds  $\times$  4 rating criteria)



The PEASS Toolkit is freely available at  
<http://bass-db.gforge.inria.fr/peass/>

- [1] **Subjective and objective quality assessment of audio source separation**, V. Emiya, E. Vincent, N. Harlander, V. Hohmann, IEEE Trans. on Audio, Speech and Language Processing, submitted, 2010.
- [2] **Multi-criteria subjective and objective evaluation of audio source separation**, V. Emiya, E. Vincent, N. Harlander, V. Hohmann, AES 38th Int. Conf. on Sound Quality Evaluation, Pitea, Sweden, June 2010.

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

Existing model for distortion decomposition [3]:

$$\hat{s}_j(t) - s_j(t) = e_j^{\text{target}}(t) + e_j^{\text{interf}}(t) + e_j^{\text{artif}}(t) \quad (1)$$

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

Defining and estimating the distortion components  $e_j^{\text{target}}$ ,  $e_j^{\text{interf}}$ ,  $e_j^{\text{artif}}$  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:

- ( $T_1$ ) Rate the *global quality* compared to the reference.
- ( $T_2$ ) Rate the quality in terms of *preservation of the target source*.
- ( $T_3$ ) Rate the quality in terms of *suppression of other sources*.
- ( $T_4$ ) 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]:

$$q_j^{\text{overall}} \triangleq \text{PSM}(\hat{s}_j, s_j) \quad (2)$$

$$q_j^{\text{target}} \triangleq \text{PSM}(\hat{s}_j, \hat{s}_j - e_j^{\text{target}}) \quad (3)$$

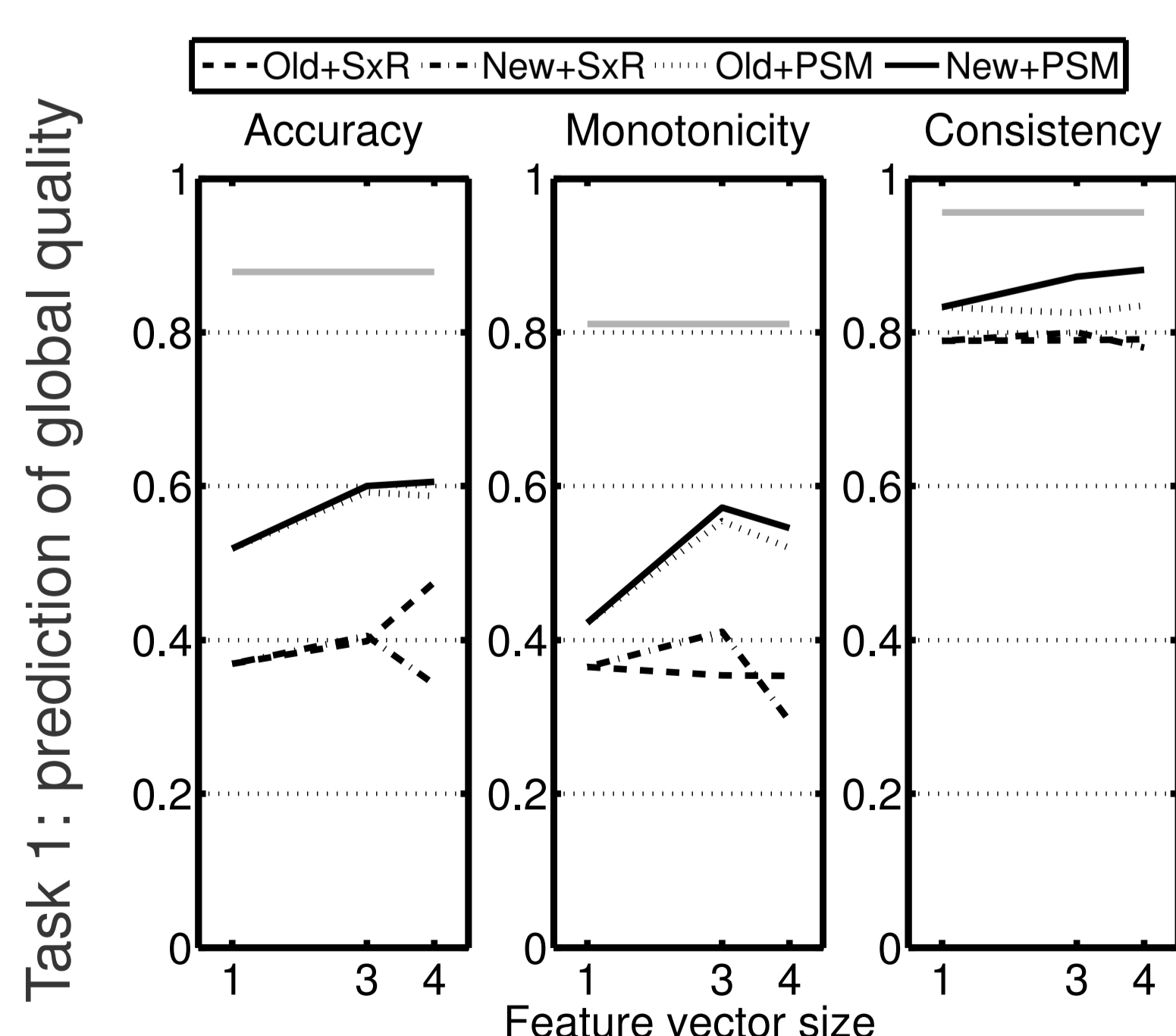
$$q_j^{\text{interf}} \triangleq \text{PSM}(\hat{s}_j, \hat{s}_j - e_j^{\text{interf}}) \quad (4)$$

$$q_j^{\text{artif}} \triangleq \text{PSM}(\hat{s}_j, \hat{s}_j - e_j^{\text{artif}}) \quad (5)$$

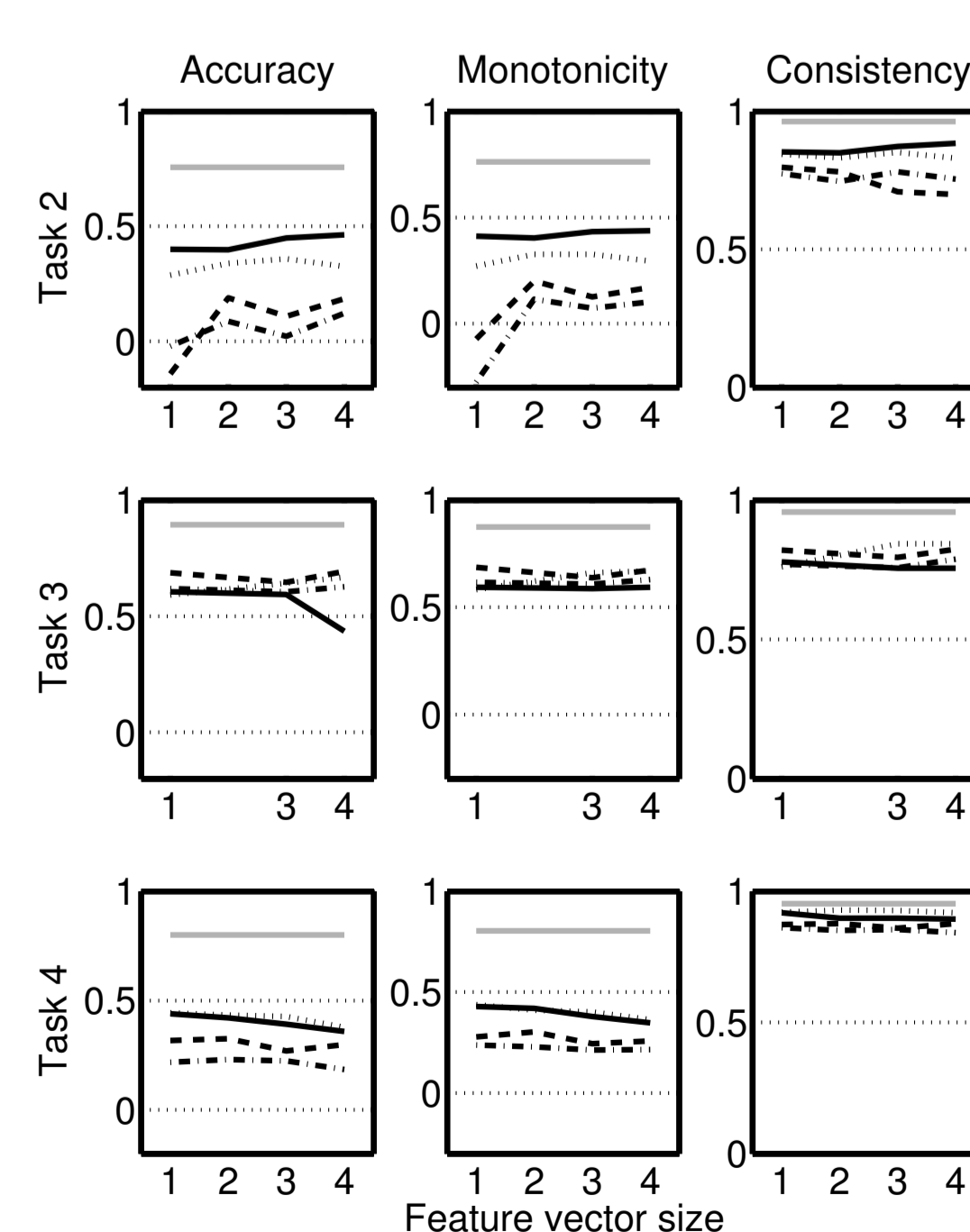
By combining the 4 features in a non-linear way to predict subjective scores ( $T_1$ ) – ( $T_4$ ), a set of objective measures is finally output:

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

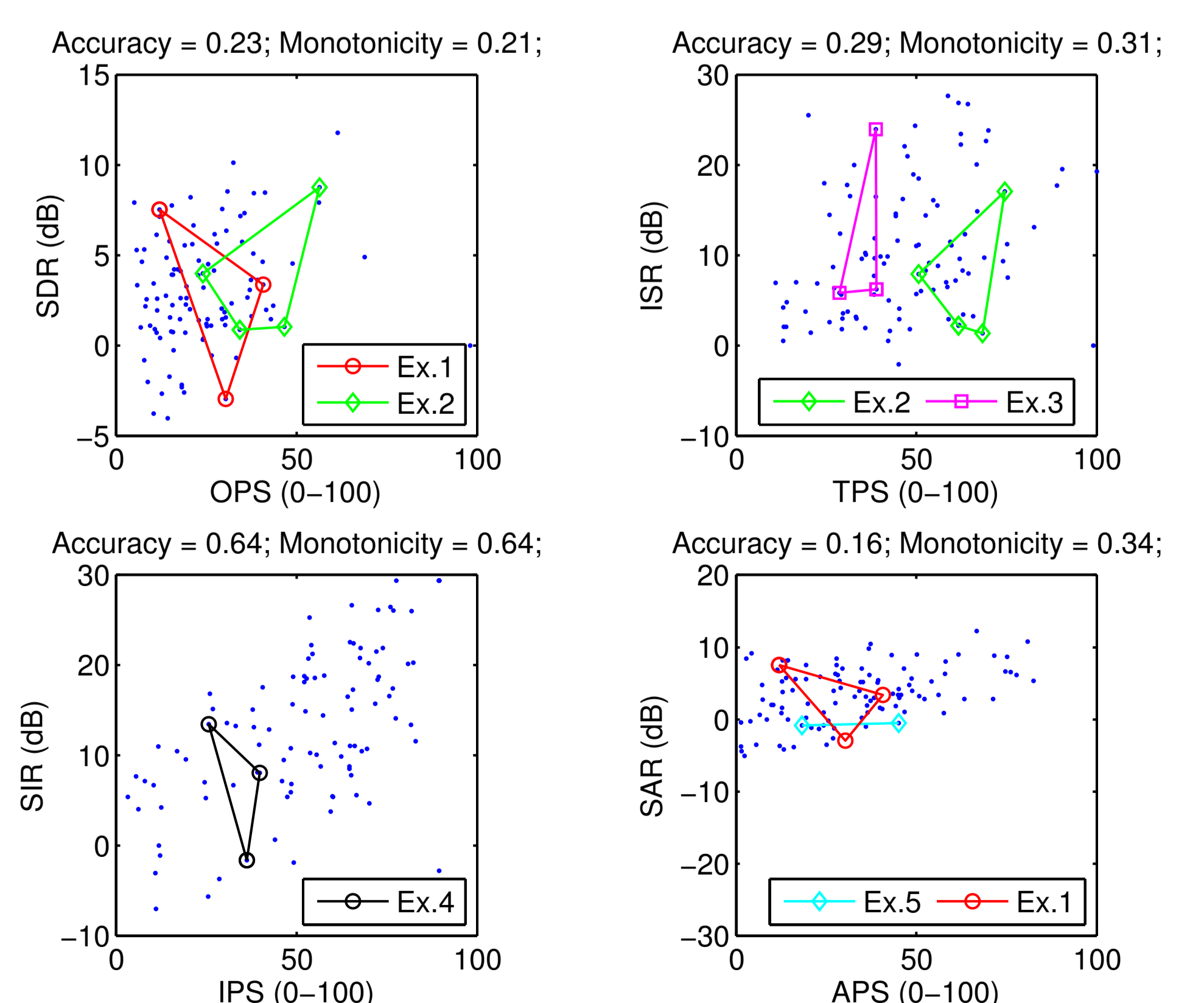
## EVALUATION RESULTS: prediction performance and evaluation at SiSEC 2010



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.



DEMO SiSEC 2010



BSS eval vs. PEASS: scatter plots of the SiSEC 2010 results for the set of Professionally produced music recordings.

[3] E. Vincent, R. Gribonval, C. Févotte, *Performance measurement in blind audio source separation*, IEEE Trans. on Acoustics, Speech and Signal Proc., 14 (4), 2006.

[4] R. Huber, B. Kollmeier, *PEMO-Q – A New Method for Objective Audio Quality Assessment Using a Model of Auditory Perception*, IEEE Trans. on Acoustics, Speech and Signal Proc., 14 (6), 2006.