Linear and Parametric Microphone Array Processing

Part 6 - Wrap-up

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1. Summary

What we covered in today's tutorial:

- Linear spatial filtering techniques for noise reduction.
- Parametric spatial filtering techniques for joint noise reduction and dereverberation.
- Informed spatial filtering techniques for joint noise reduction and dereverberation.

Some general conclusions:

- Microphone array processing in adverse environments remains challenging.
- Different perspectives lead to very different solutions.
- Multi-microphone processing is not (yet) as mature as single-channel processing.

2. Linear Spatial Processing

LCMV beamformers (and Co.) exhibit many advantages:

- Low distortion and high interference cancellation.
- Practical estimation and tracking procedures.
- Extendable to binaural algorithms for hearing aids.
- The use of the RTF allows for:
  - Shorter processing frames.
  - Higher noise reduction (traded-off for dereverberation).
  - Preservation of binaural cues.
- Distributed versions (with enhanced capabilities) exist.

Many challenges remain:

- Arbitrary speakers' activity patterns.
- Improved tracking of moving speakers and sensors.
- Reduce the number of parameters to be estimated.
- Reduce latency.

3. Parametric / Informed Spatial Filtering

Parametric / Informed spatial filtering exhibits many advantages:

- Parametric spatial filtering techniques are very robust and flexible. But model violations often introduce audible artifacts.
- Informed spatial filtering allows us to incorporate "instantaneous" information about the acoustic scene in the design of spatial linear filters and can therefore make use of various tradeoffs.

Many challenges remain:

- Robust parameter estimation (RTF, DOA, etc.) in noisy and reverberant environments.
- More sophisticated, yet simple, parametric models are required to further increase the performance.
- Challenge to mitigate audible artifacts when using spatial filters that change quickly across time and frequency.
- For communication systems, we also need to take into account the acoustic coupling between loudspeakers and microphones (i.e., echo).

Thank you for your attention!