Robust Sound Source Localization considering Similarity of Back-Propagation Signals

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Key Idea

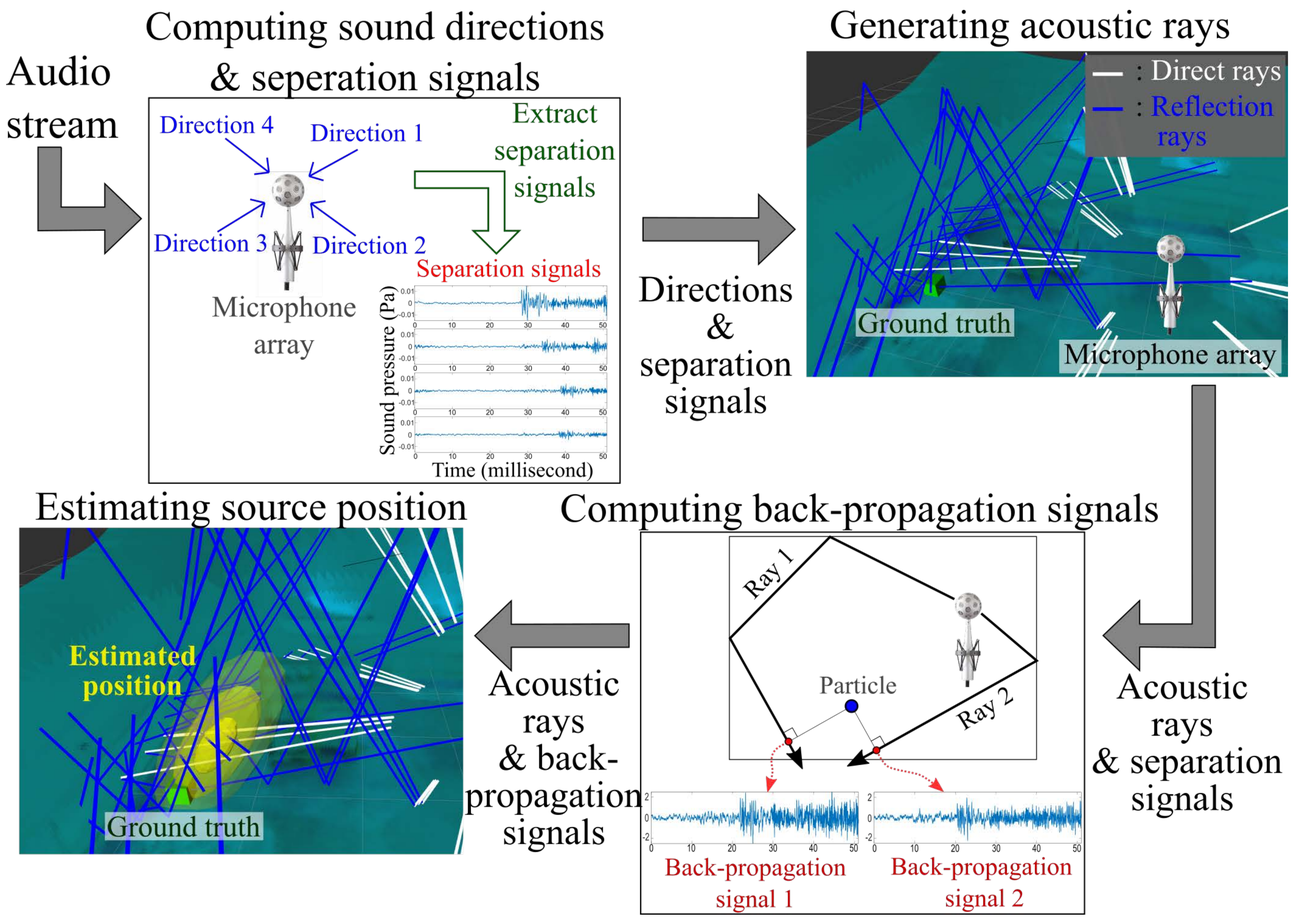
- The input signals measured at the microphone consist of many different signals through different propagation paths of sound.
- Restore the sound signals (back-propagation signals) on a particular position on those propagation paths.
- Back-propagations are similar near the source position.

Benefits

- Localize a source position with an average accuracy error of 0.51m (in a 7m*7m*3m room) for a moving source
- Observe 65% to 220% improvement in accuracy by considering back-propagation signals over the state-of-the-art method.
- Support complex environments including a moving source, an obstacle, and noises.

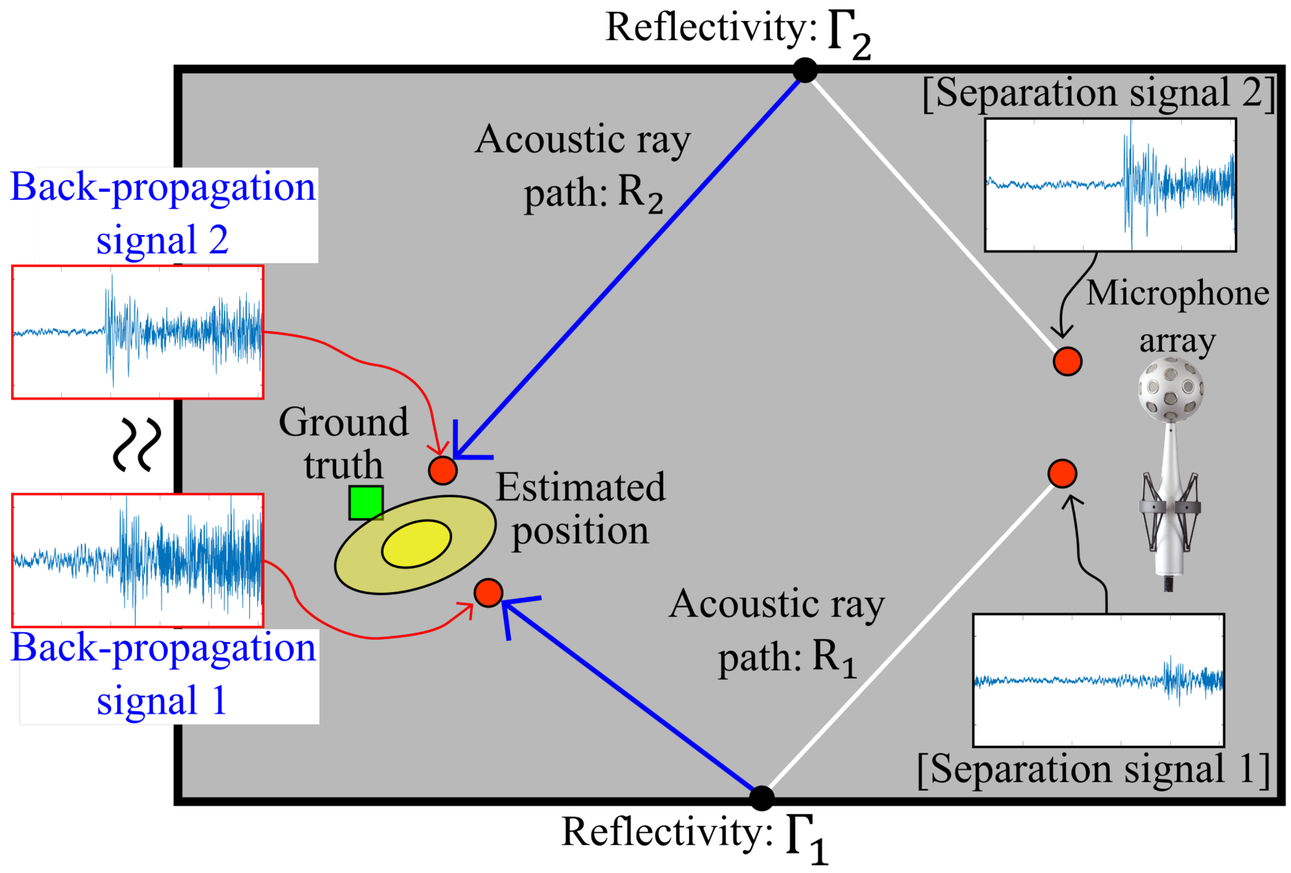
Back-Propagation signals

- **Overview of our algorithm**



- Incoming directions and separation signals of each incoming direction are computed by the beamforming algorithm from the audio stream.
- Perform acoustic ray tracing supporting direct and reflection effects [1] [2].
- The source position is computed by considering similarities of back-propagation signals.

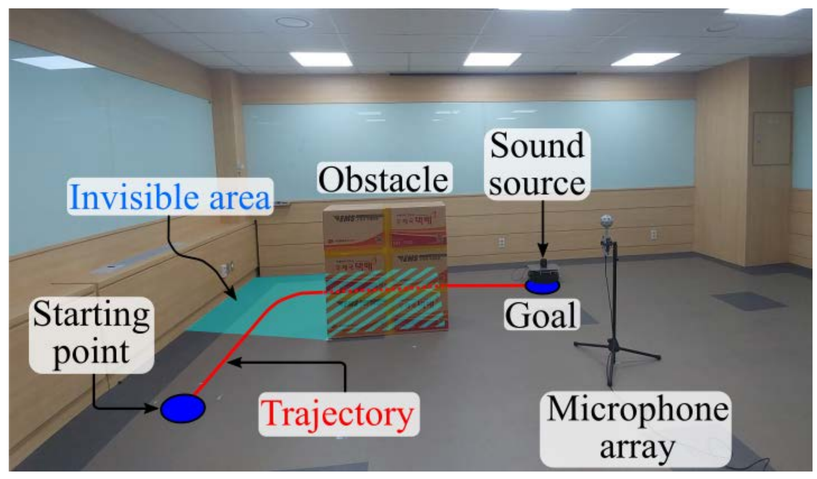
- **Back-propagation signal**



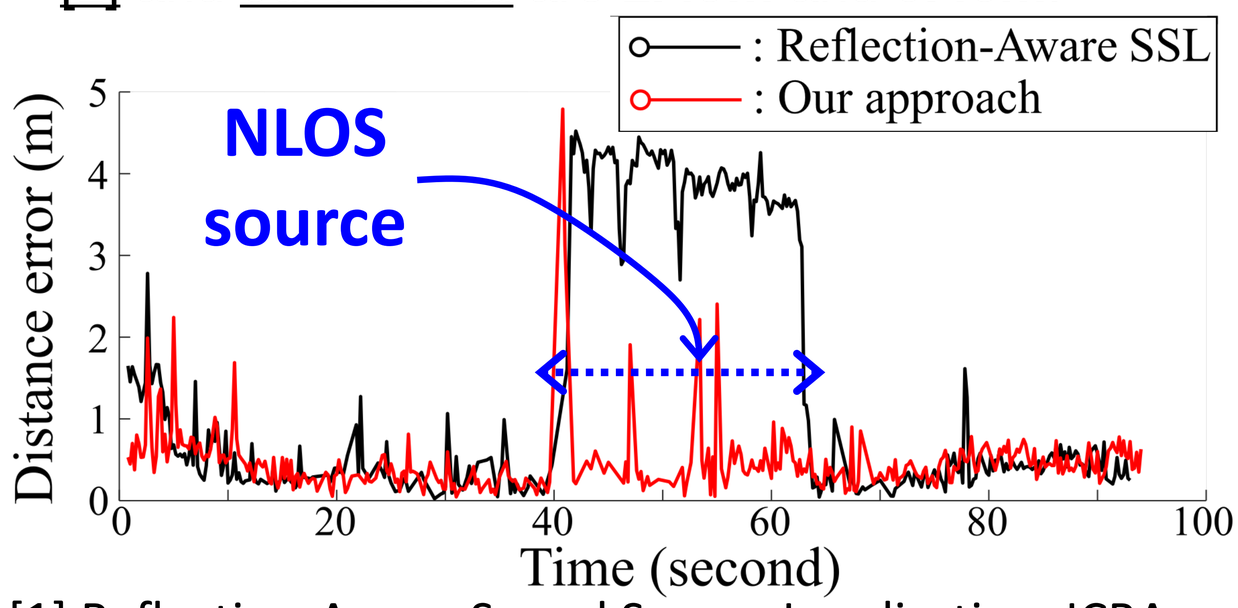
- Generate back-propagation signals using backward impulse response based on acoustic ray paths.
- Improve the localization accuracy by considering similarities of back-propagation signals; the similarities become higher when particular position of back-propagation signals are closer to the ground truth.

Results

- **Moving sound source around an obstacle**



- The environment:
- The average distance errors of the RA-SSL [1] and our method are **1.49m** and **0.46m**.



[1] Reflection-Aware Sound Source Localization, ICRA 2018

[2] Diffraction-Aware Sound Localization For a Non-Line-of-Sight Source, ICRA 2019

This research was supported by the SW StartLab program (IITP-2015-0-00199).