Time of arrival localization algorithms
Increasing acoustic location accuracy by reducing time of arrival estimation errors

John Burt
University of Washington

Array Playback Recording:
Gail Patricelli
Alan Krakauer

Least Squares best-fit acoustic location code
Dave Mellinger

Sources of time delay error

- Low signal to noise ratio:
  - signal too quiet at channel
  - high background noise
- Other sounds overlapping with target sound
- Acoustic degradation due to distance

Time of Arrival based Acoustic location method
Waveform cross correlation

calculate best-fit location
(pairwise channel cross-correlation)

How to we make this work better?

22 m unfiltered
srmv332kpc2127

141 m unfiltered
srmv332kpc16357

64 pt FFT 10% overlap
Whitening threshold filter

magnitude bins below threshold set to zero

2007 sage grouse array playback

Microphone channels

Playback positions

Playback stimuli

Playback regime

<table>
<thead>
<tr>
<th>Stim species</th>
<th>#Stim examples</th>
<th># reps p1</th>
<th># reps p2</th>
<th># reps p3</th>
<th># reps p4</th>
<th># reps p5</th>
<th># reps p6</th>
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</table>
results analysis

- Locate all playback sounds using different pre-filter conditions:
  - waveform xcorr, no filter
  - waveform xcorr, 95% whitening filter
  - spectrograph xcorr, no filter
  - spectrograph xcorr, 75% whitening filter
  - spectrograph xcorr, 95% whitening filter

- Separate “good locs” from “bad locs” (error distance > 100m)

- Analyse effect of pre-filter on:
  - good loc error
  - number of bad locs
  - differences across species

Summary

- Whitening filters reduce time delay estimation error
- Best combination for accurate “good” locs: waveform cross correlation + 95% whitening filter
- Best combination for reducing “bad” locs: spectrograph cross correlation + whitening filter
- Many other pre-filtering possibilities
- All source code will be made available to workshop participants

Thanks to:
  Alan Krakauer
  Gail Patricelli
  David Mellinger