Automatic Detection of Brown-headed Cowbird Song in Urban Environments

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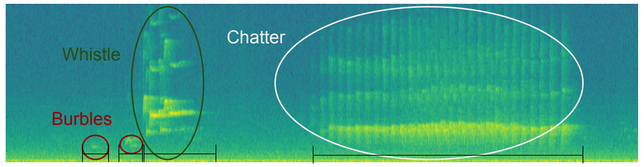
Introduction

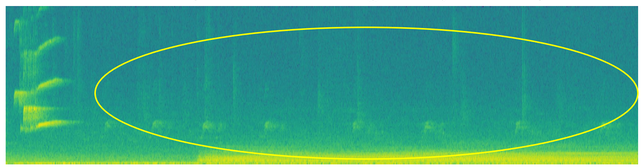
- 24/7 cameras and microphones let us study the group dynamics of an entire flock of cowbirds
- The end goal is to build a "smart aviary" which automatically processes raw video and audio into behavioral data

Question

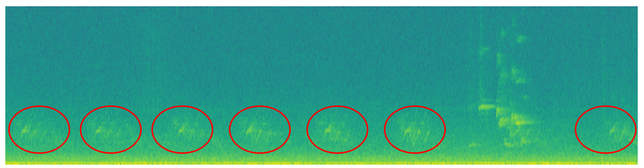
- How to automatically identify when calls occur?
- Types of calls



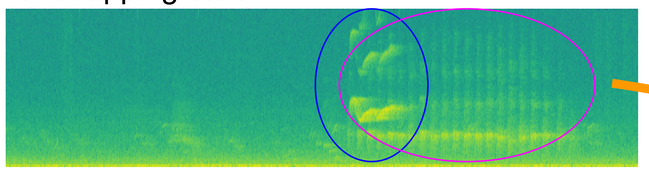
- Complications:
- Urban noise (trains and highway traffic)



- Calls of other bird species

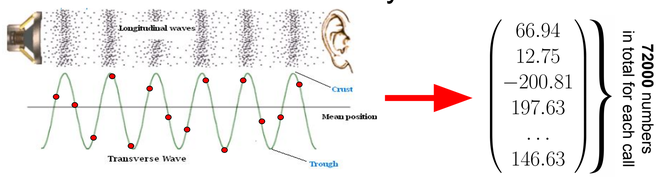


- Overlapping calls

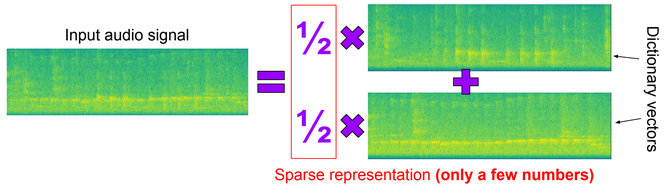


Methodology

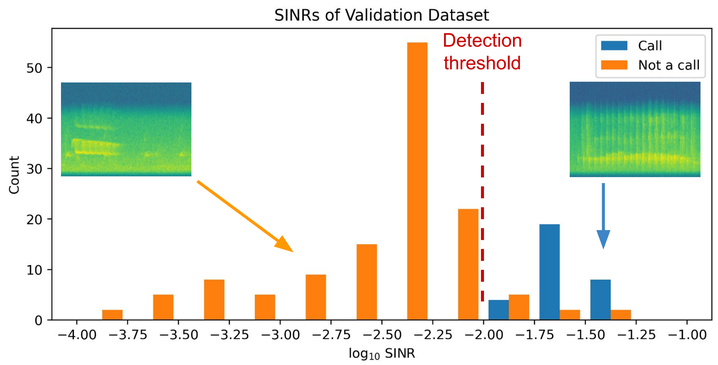
- Example calls were manually annotated and then converted to "dictionary" vectors



- We build a *sparse representation* (SR) of each audio segment in terms of these vectors using a process called *orthogonal matching pursuit*



- The SR tells us the amount of *signal* in the audio sample, and what is left over is the *noise*—using this, we can calculate the *signal-to-noise ratio* (SINR)
- Samples with high SINR are detected as calls and samples with low SINR are ignored

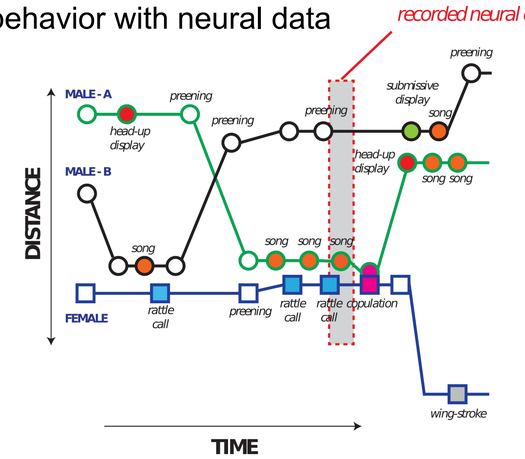


Results

- We used an *ROC curve* in order to find an optimal value for the threshold
- Using this threshold, we were able to successfully identify 94% of the validation call dataset with only 5% error

Next Steps

- The end goal is to completely characterize the behavior of birds automatically and combine behavior with neural data



- Sound detection can be combined with sound localization and bird position information to auto-detect which birds are singing when