Active control of receiver morphology of freely flying bats during prey capture

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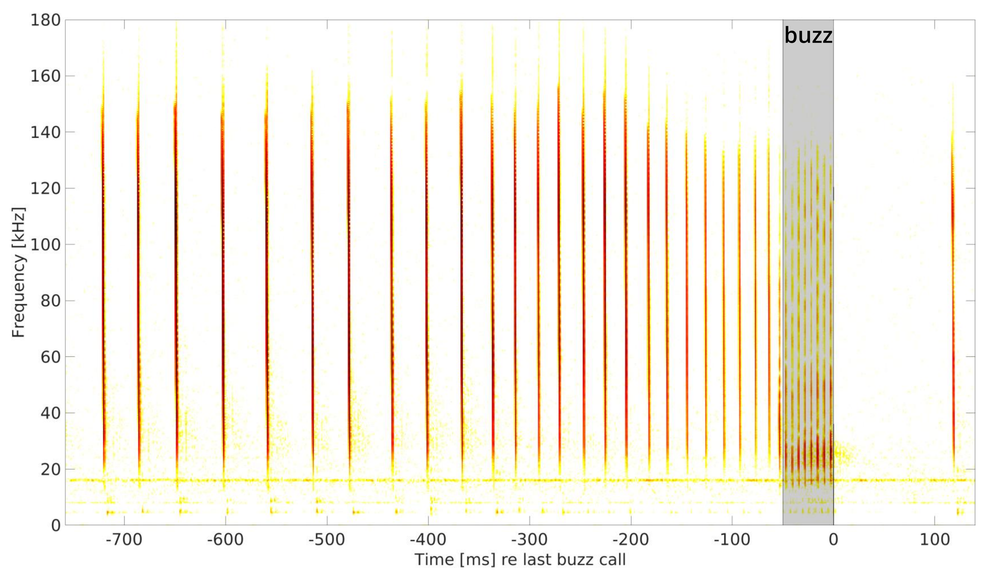
Introduction

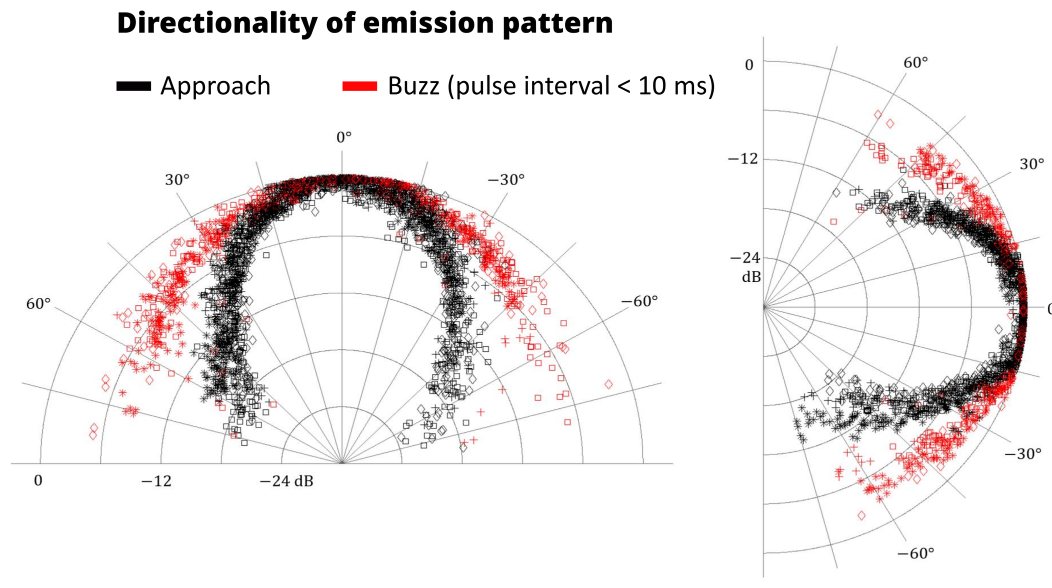
Vespertilionid bats actively control their acoustic scene by adjusting intensity, duration, frequency and directionality of their emitted calls. They broaden their beam upon target approach to increase their acoustic field of view by lowering the frequency of their signals in the terminal phase, the so-called buzz. The wider beam allows the bat to better detect evasive prey at close range. (Jakobsen & Surlykke, 2010 , Jakobsen et al., 2013)

However, emission is only one part of this active sensing system. Reception is highly important as it decodes the acoustic cues contained in returning echoes. Yet, little is known on the receptive field adjustments of hunting bats.

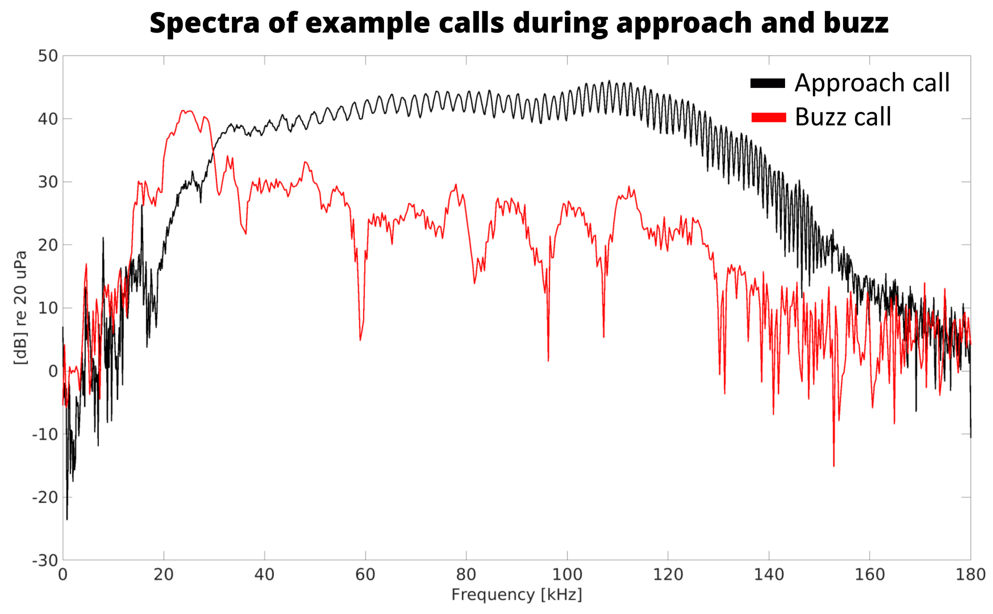
Capture Sequence of a *Myotis nattereri*



Directionality of emission pattern

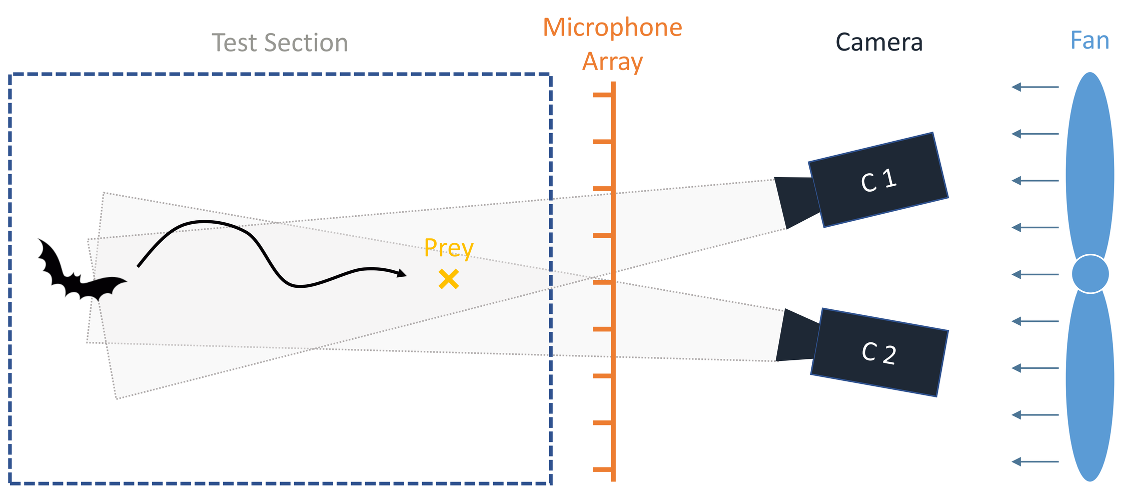


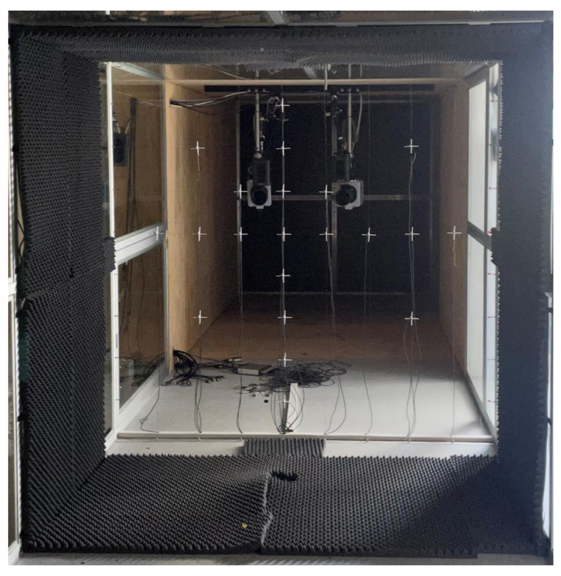
Spectra of example calls during approach and buzz

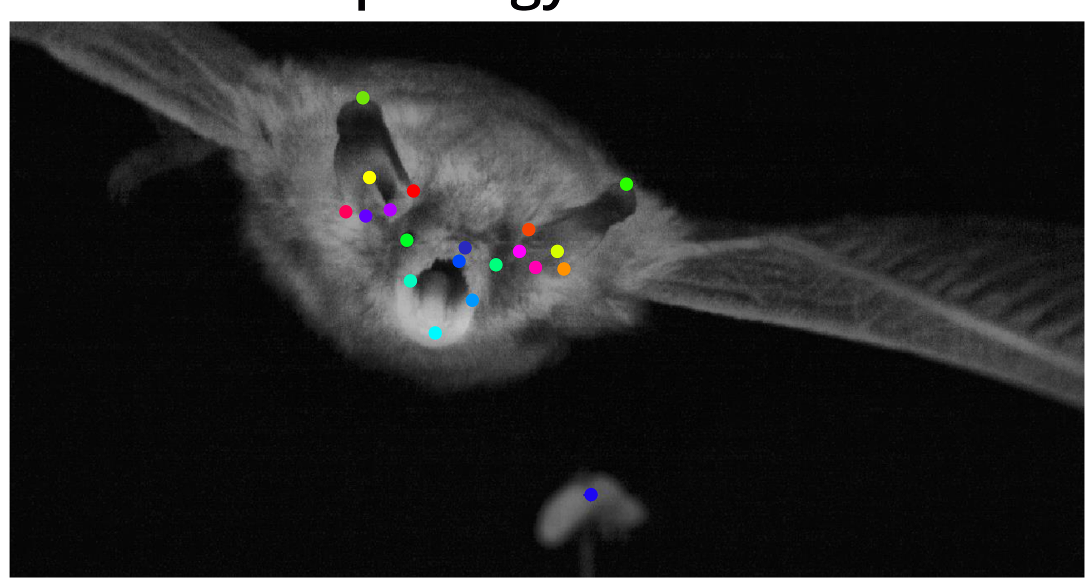


Methods

Four male *Myotis nattereri* are recorded capturing mealworm prey in the test section of the wind tunnel at the University of Southern Denmark (SDU). We used 21 GRAS ¼" microphones (star shaped array) and 2 high-speed cameras (Photron FASTCAM SA1.1, 675K-M2) to map out the emitted beam and observe 20 distinct facial landmarks for 3D morphology reconstruction.

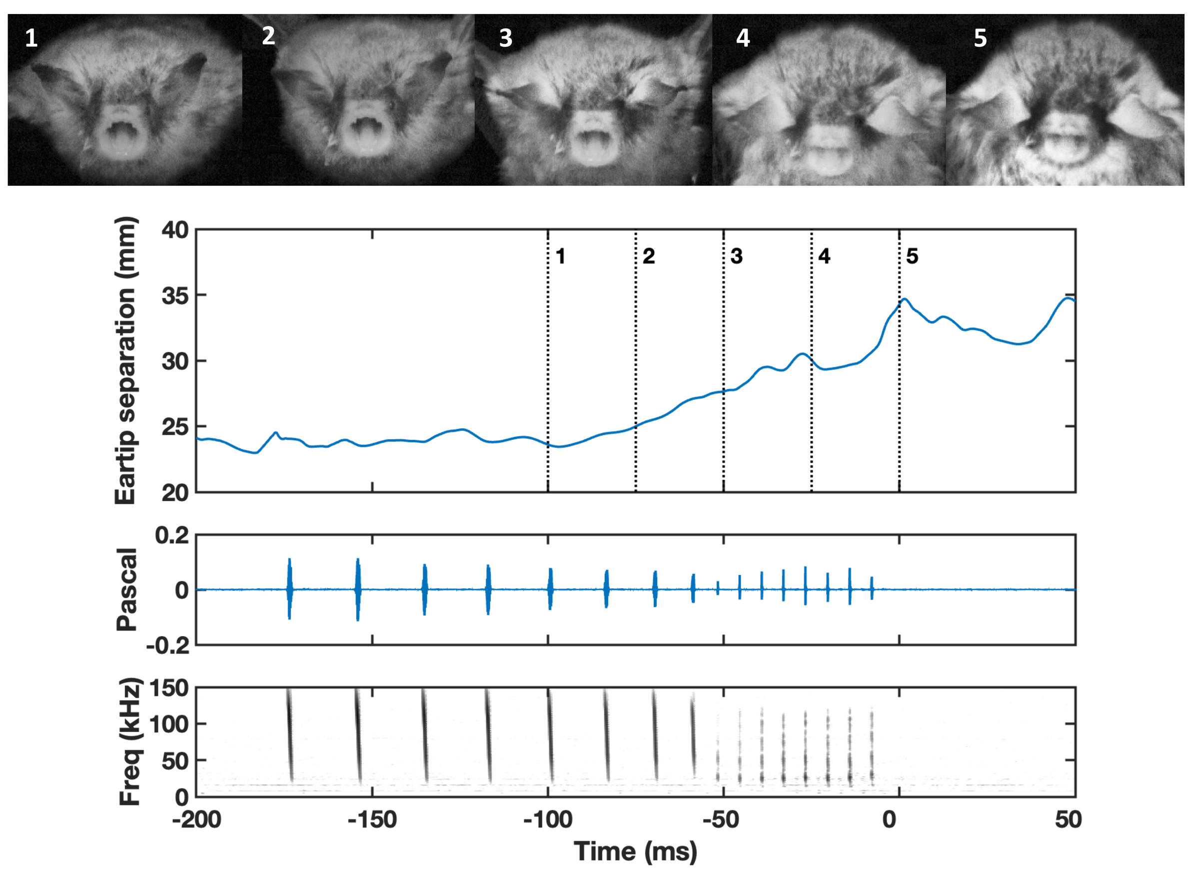




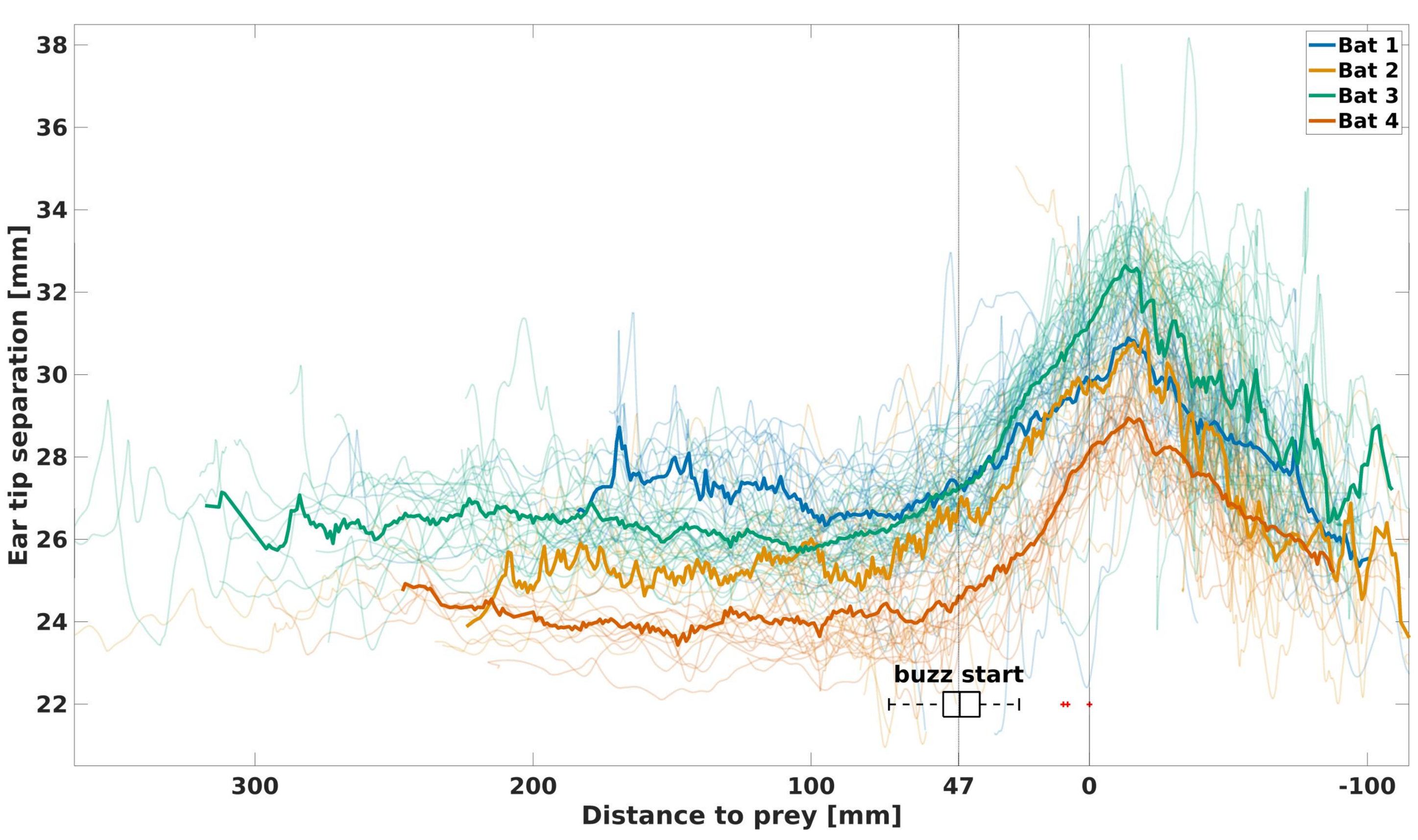


Preliminary Results & Conclusion

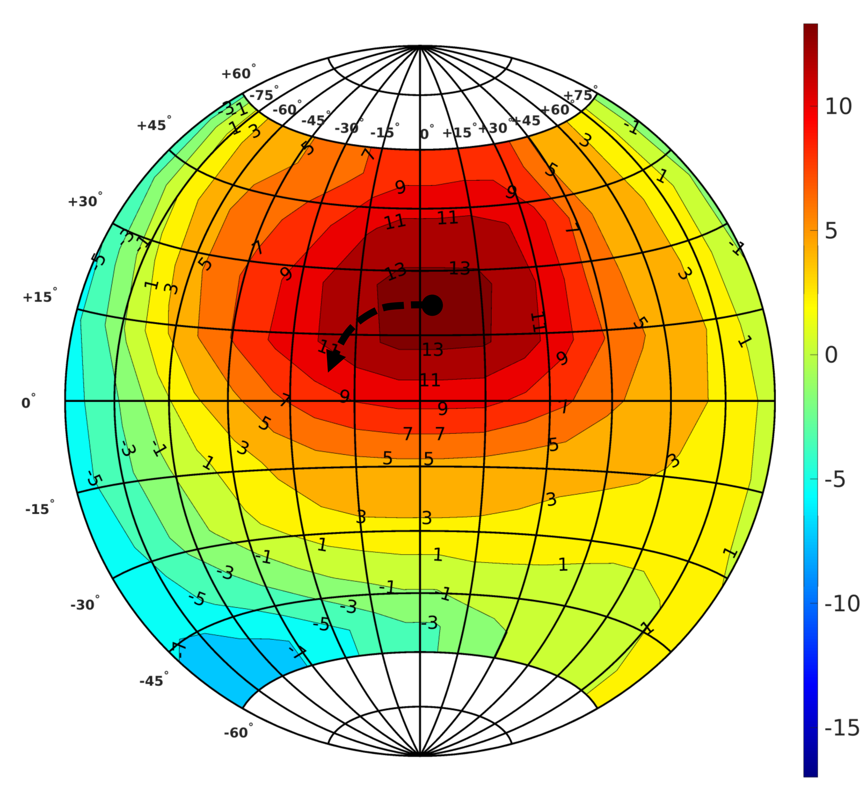
Single trace of ear tip separation during prey capture



Averaged ear tip separation data of 113 trials of four individuals over distance to prey



Measured hearing directionality of a *Myotis nattereri* with approximated receiver motion



- Bats perform a forward-downward-outwards ear motion that is highly correlated with the beam broadening during buzz.
- Ear-tip separation as a proxy for ear motion indicates dynamic receiver adjustment in final stages of prey capture (buzz II).
- Dynamic adjustment of receiver morphology supports the broadening of the echolocation beam.

We propose that bats actively move the highest amplified hearing-direction down and outwards, broadening the receptive field to better track echoes of potentially escaping prey.

→ *Myotis nattereri* dynamically control both, sound emission and echo reception!