SES11-2011-000015

Abstract for an Invited Paper
for the SES11 Meeting of
the American Physical Society

The physics of bat biosonar

ROLF MÜLLER, Virginia Tech

Bats have evolved one of the most capable and at the same time parsimonious sensory systems found in nature. Using active and passive biosonar as a major - and often sufficient - far sense, different bat species are able to master a wide variety of sensory tasks under very dissimilar sets of constraints. Given the limited computational resources of the bat's brain, this performance is unlikely to be explained as the result of brute-force, black-box-style computations. Instead, the animals must rely heavily on in-built physics knowledge in order to ensure that all required information is encoded reliably into the acoustic signals received at the ear drum. To this end, bats can manipulate the emitted and received signals in the physical domain: By diffracting the outgoing and incoming ultrasonic waves with intricate baffle shapes (i.e., noseleaves and outer ears), the animals can generate selectivity filters that are joint functions of space and frequency. To achieve this, bats employ structural features such as resonance cavities and diffracting ridges. In addition, some bat species can dynamically adjust the shape of their selectivity filters through muscular actuation.