

“Acoustic relationships of bats to themselves and to other individuals during echolocation”

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Bats have an advanced SONAR system. By comparing emitted ultrasounds with returning echoes, bats can instantly recognize the physical characteristics of their surroundings, enabling them to capture prey, avoid collisions with obstacles and other individuals in complete darkness. While many animals use visual information for navigation, the perceptual mechanisms of bats using auditory information has many biologically interesting features and also contains useful engineering insights. In order to reveal the advanced acoustic navigation of bats, we are measuring bat acoustic and flight behavior using several measurement techniques, from behavioral measurements on captive bats in the laboratory to biologging to study the large-scale movement ecology of bats in the wild. In this presentation, I would like to introduce some experimental data obtained so far on the navigation behavior of bats from the individual level to the group level.

Most bats live in confined spaces such as caves, where they form colonies with other individuals. For example, just before they come out of the cave to forage at dusk, several bats are observed flying around simultaneously in a small space. In doing so, the bats encounter a serious problem unique to echolocating animals: the situation of acoustic jamming within the group. In order for bats to correctly sense their surroundings, they need to extract only their own echoes from the complex mixture of ultrasounds emitted by neighboring conspecifics and their echoes. In this presentation, I will present the results of behavioral experiments and an engineering perspective on how bats cooperate with each other to avoid the acoustic interference during group flight.

It is also believed that the advanced navigation of bats is achieved through the coordination of acoustic behavior and flight control. Preliminary data measured in the field on the collective flight of bats as they emerge from caves will also be presented.