PROJECT TITLE: Robotic models of bat echolocation

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Project Description

Background

Many species of bats exhibit remarkable echolocation behavior. So far, many of these feats of biosonar remain unexplained. My research focuses on modeling the sensorimotor loops underlying the behavior. In engineering terms, I want to understand what control loops support the observed behavior.

So far, I have mainly used simulation methods. However, recently I have started developing robotic models of bat echolocation. This is because it is very hard to model the echoes received by bats realistically. In contrast, a robot, operating in an environment that returns real echoes, faces the same challenges as a bat and has access to the same acoustic cues. Moreover, these change in a realistic fashion as the robot moves through the environment. Therefore, as in many other fields of sensory ecology, the bio-robotic approach is a prime method for generating and testing hypotheses about which acoustic cues can be exploited in sonar-based behavior.

Currently, I am building and instrumenting a small (20 by 15 cm) mobile robot with an ultrasonic data acquisition device consisting of a Polaroid speaker and two ears (microphones). We will deploy the robot in the Motion Capture Lab at the Department of Psychology. This will enable us to capture its movements using a 20 camera motion tracking system.
Depending on your interest, a wide range of projects could be defined in the context of the ongoing work. We will work together to find a project that fits your learning expectations and could include the following elements:

+ Implementing and running robotic experiments
+ Optimizing the design and software of the robot
+ Computer simulations of bat echolocation behavior
+ Acoustic characterization of the robot's sonar system.
+ Collecting sonar data from objects that are relevant in bat echolocation
+ Electronic circuit design/software development

Learning opportunities

The learning opportunities will depend on the project we define. The acquired skills could include:

+ Robot design and building using modular electronics
+ CAD design in SolidWorks and fabrication using 3D printing.
+ Designing and running robotic experiments
+ Collection and analysis of acoustic data
+ Collection and analysis of motion tracking data
+ Data visualization
+ Presenting in a seminar