ACOUSTICS2008/1774
Vocal motor control in horseshoe bats - a bottom-up approach

Kota Kobayasi, Steffen Hage, Jie Ma and Walter Metzner
UCLA, Dept. Physiol. Sci., Box 951606, Los Angeles, CA 90095, USA

Most animals constantly adjust the spectrotemporal composition of their vocalizations depending on the information content intended to be conveyed by these signals. Whereas most studies focus on the sensory processing of spectrotemporal features of vocalizations in various vertebrates, it is still widely unknown how vocal motor structures in the brain adjust these call parameters. We used echolocation and acoustic communication behaviors in horseshoe bats to analyze the neurobiological and biomechanical basis for the motor control of their vocalizations. Results from pharmacological studies of the vocal motor nucleus, the nucleus ambiguus, lead us to developed a novel model for call frequency control by vocal motor neurons. Neurophysiological recordings combined with pharmacological manipulations at the single cell level in spontaneously vocalizing bats substantiated this model. Biomechanical properties of the larynx were also found to aid in call frequency control: Altering tracheal air flow in an isolated larynx preparation resulted in two distinct frequency bands that were non-harmonically related and reflected the main frequency components of echolocation pulses and communication signals, respectively. In addition, changes in air pressure revealed transitions from periodic to chaotic that occurred within a single signal cycle, giving rise to spectral features observed in horseshoe bat communication signals.