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Mechanisms of Wing Beat Sound in Flapping Wings of Beetles[1]

JOHN ALLEN, University of Hawaii — While the aerodynamic aspects of insect flight have received recent attention, the mechanisms of sound production by flapping wings is not well understood. Though the harmonic structure of wing beat frequency modulation has been reported with respect to biological implications, few studies have rigorously quantified it with respect directionality, phase coupling and vortex tip scattering. Moreover, the acoustic detection and classification of invasive species is both of practical as well scientific interest. In this study, the acoustics of the tethered flight of the Coconut Rhinoceros Beetle (Oryctes rhinoceros) is investigated with four element microphone array in conjunction with complementary optical sensors and high speed video. The different experimental methods for wing beat determination are compared in both the time and frequency domain. Flow visualization is used to examine the vortex and sound generation due to the torsional mode of the wing rotation. Results are compared with related experimental studies of the Oriental Flower Beetle.

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