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How hummingbirds hum: Acoustic holography of hummingbirds during maneuvering flight BEN HIGHTOWER, Stanford University, PATRICK WIJNINGS, Sorama and University of Eindhoven, RIVERS INGERSOLL, DIANA CHIN, Stanford University, RICK SCHOLTE, Sorama, DAVID LENTINK, Stanford University — Hummingbirds make a characteristic humming sound when they flap their wings. The physics and the biological significance of hummingbird aeroacoustics is still poorly understood. We used acoustic holography and high-speed cameras to determine the acoustic field of six hummingbirds while they either hovered stationary in front of a flower or maneuvered to track flower motion. We used a robotic flower that oscillated either laterally or longitudinally with a linear combination of 20 different frequencies between 0.2 and 20 Hz, a range that encompasses natural flower vibration frequencies in wind. We used high-speed marker tracking to dissect the transfer function between the moving flower, the head, and body of the bird. We also positioned four acoustic arrays equipped with 2176 microphones total above, below, and in front of the hummingbird. Acoustic data from the microphones were back-propagated to planes adjacent to the hummingbird to create the first real-time holograms of the pressure field a hummingbird generates in vivo. Integration of all this data offers insight into how hummingbirds modulate the acoustic field during hovering and maneuvering flight.

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