How hummingbirds fight the wind: Robotic device helps analyze hovering birds

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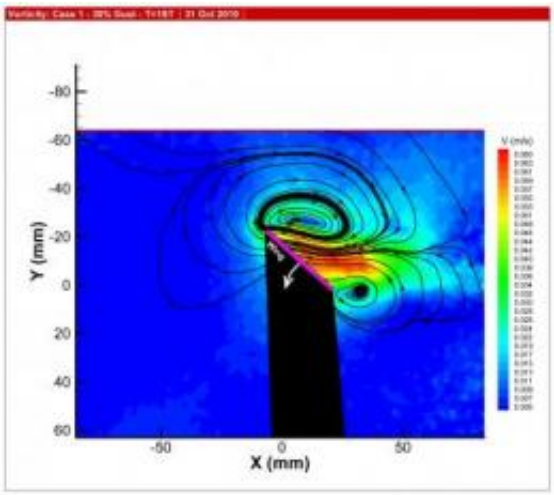

In the presence of a strong gust (30 percent from left to right), both leading and trailing edge vortices were observed during downstroke at a Reynolds number of 1400 (Strouhal number = 0.28). Credit: Courtesy: New Mexico State University.

Hummingbirds rank among the world's largest and most accomplished hovering animals, but how do they manage it in gusty winds?

A team of researchers at New Mexico State University, Los Alamos National Laboratory, Technische Universiteit Eindhoven, and Continuum Dynamics Inc. has built a robotic hummingbird wing to discover the answer, which they describe today at the American Physical Society Division of Fluid Dynamics (DFD) meeting in Long Beach, CA

Hummingbirds do not fly like other birds, whose wings flap up and down, explained B.J. Balakumar of the Extreme Fluids Lab at Los Alamos National Laboratory. Instead, their wings oscillate in a figure eight pattern to produce lift on both the downstroke and upstroke. They achieve the extra lift they need to hover by creating a vortex on the leading edges of their wings.

Such vortices are inherently unstable. "The birds, though, are very clever," Balakumar said. "Their wings create the vortex with a high angle of attack on the downstroke. Then they flip their wings around on the upstroke, so as they shed one vortex, they create another on the other side of the wing, thereby managing to maintain high lift forces."

A gust of wind could pull those vortices off the wing. Instead, hummingbirds continually readjust their wing angles to maintain high lift forces.

The researchers' robotic wing will attempt to replicate that feat in gusty conditions. They hope to identify robust algorithms that will allow the creation of stable ornithopters that can operate reliably under real-life conditions for surveillance and other applications.

More information: The presentation, "Effect of gust on flow patterns around a robotic hummingbird wing" is on Sunday, November 21, 2010. Abstract: meetings.aps.org/Meeting/DFD10/Event/132368

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