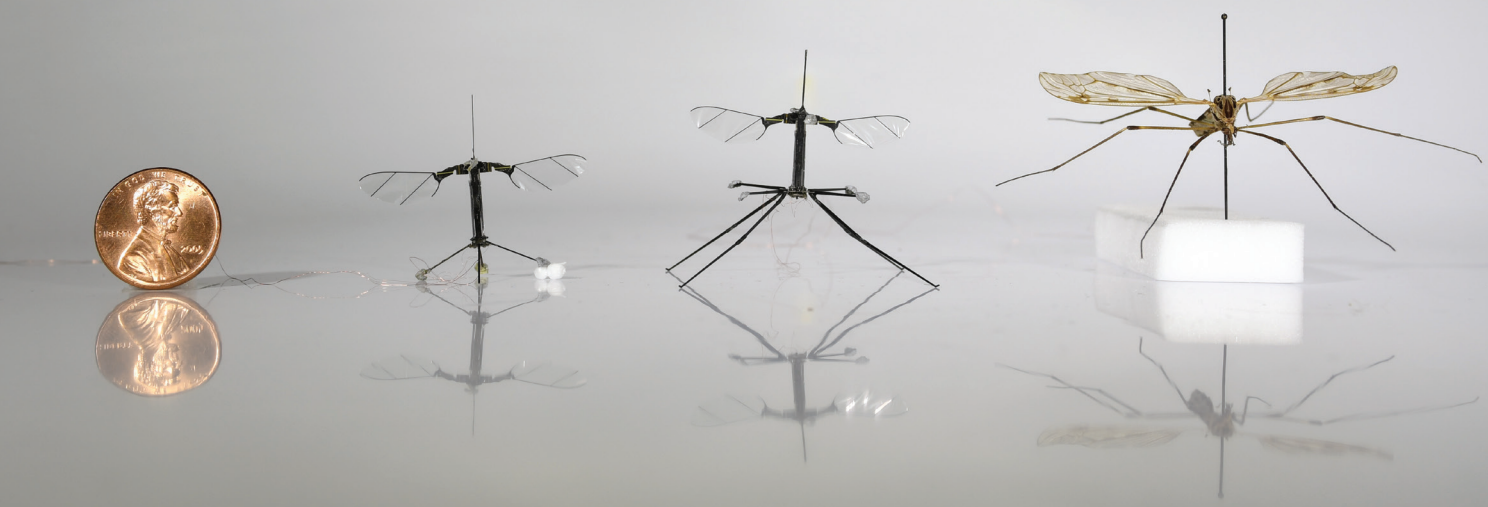

Soft touchdowns for tiny robots

For insect-scale flapping-wing robots, landing is perhaps the most dangerous portion of flight. Close to the ground, the wings generate unpredictable air vortices that often cause hard or crash landings. The rigid, single-segment legs that researchers typically use on the robots struggle to reliably cope with the collision forces generated during landings, which can easily damage fragile components such as the wings or the piezoelectric or electromagnetic actuators that power the devices.

To create robots that can achieve smoother landings, a team led by Nak-seung Hyun of Purdue University and Christian Chan of Harvard University looked to the crane fly, a larger cousin of the mosquito. With its long, flexible legs, the crane fly is known for its ability to land gracefully on various surfaces. The insect's legs comprise two joints and two deformable segments—the upper tibia and the lower tarsus. Both the joints and the flexibility of the segments help the insect's legs dissipate energy on landing.

To emulate crane fly legs, Hyun, Chan, and their team fitted an existing insect-scale robot, the Harvard RoboBee, with two deformable joints made of carbon fiber and polyimide film and rigid leg segments made of carbon fiber. The joints were laminated with a thermoplastic elastomer that served as a damping element. After experimenting with varying lengths for the tibia and the tarsus, the researchers found that the optimal leg design was one like the crane fly's, in which the tarsus makes up 60% of the leg's total length. The photo shows the prior iteration of the RoboBee (second from left) and the new version with deformable legs (second from right), alongside a US penny and a crane fly specimen for scale.

Like the insect that inspired it, the new RoboBee can successfully take off and land on the leaf of a plant. The researchers hope that with additional refinement, insect-scale robots will be able to help live bees pollinate flowers. (N.-S. P. Hyun et al., *Sci. Robot.* **10**, eadq3059, 2025; photo courtesy of Harvard Robotics Lab/Christian Chan.) —RD

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