

## Study of bat flight could improve autonomous flying vehicles

by Gregg Kleiner

CORVALLIS, Ore. — A mechanical engineering professor and graduate students at Oregon State University will play a critical role in a \$6 million joint research project aimed at better understanding how bats maneuver so effectively during flight.

The research, funded by the U.S. Air Force, could one day lead to micro flying machines capable of navigating cluttered environments such as urban landscapes or dense forests.

“Bats have amazingly effective maneuverability,” said Belinda Batten, head of the OSU Department of Mechanical Engineering and the lead researcher on the OSU team. “Bats also use echolocation, or biological sonar, and they can fly at night. We want to learn more about how bats sense objects in their path and adjust their flight accordingly.”

Anyone who has experienced turbulence while flying in an airplane knows why large, fixed-wing aircraft are limited in maneuverability. Having to design for the safety of human occupants strapped inside these aircraft limits how quickly they can turn, climb, or drop.

On the other hand, if an aircraft is autonomous, the options for maneuverability open up, Batten said.

“Imagine if you had a flying machine that could tumble, flutter, roll, or hit something, fall to the ground, then get up and fly again—the way a bird can hit a window, lie momentarily stunned, then fly off again.”

Current autonomous aircraft, or drones, are limited in maneuverability and in where they can successfully fly. Autonomous flying vehicles with greater maneuverability could be used to locate stranded hikers in rugged terrain, or earthquake victims trapped in damaged buildings.

Biologists have long studied bats, and engineers have analyzed the flight mechanics of birds and insects, but the two disciplines have rarely collaborated on bat flight research. That’s what makes this project unique, Batten said.

“Because biologists and engineers approach things from very different perspectives, the Air Force hopes that assembling a multidisciplinary team of engineers and biologists will yield more comprehensive results,” Batten said. “Engineers tend to focus on processing, while biologists focus more on sensors and control effectors.”

But reflexes in animals are not processed in an engineering processing sense, Batten said. When you touch a hot stove, for example, you instantly pull away your hand, without thinking.

“If you think of every feather on a bird’s wing as a type of sensor, its flight is being constantly monitored and adjusted according to the feedback these sensors are picking up, with very little processing,” Batten said. “On a bat it is similar, but the maneuverability is much more advanced and they are flying in the dark at high speeds. We want to learn more about how they can do that.”

The project is a Multidisciplinary University Research Initiative and brings together researchers with different skill sets from four universities. At Brown University, the lead institution, an aerodynamicist and a bat biologist will study the structural aspects of how bats fly. Computational researchers at MIT will develop the necessary computer models. A bat neurologist at the University of Maryland will help understand what the sensors on the bats measure, and Batten and her students at OSU will work on understanding the flight control system of the bat.

“By taking data from these other groups of researchers, we will be trying to gain insight into how the bat uses this information to control its flight,” Batten said.

The goal of the project, researchers say, is not to develop a plane that flies like a bat, but rather to learn about how bats fly, and use that information to develop better control and operation of micro air vehicles. These are generally described as having wingspans of between six and 20 inches.

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