By Mihai Andrei, Science Editor

The Secret of the Dragonfly Flight Revealed

Four wings are better.

The dragonfly is the aerial stunt of the insect world. Dragonflies were amongst the first insects to fly, about 300 Ma ago. 290 Ma ago, the dragonflies had a wingspan of 68 cm (2.3 ft). They can fly fast, up to 60 km (37 mi) per hour, which is an amazing feat for an insect, but also slowly, backwards (the hummingbirds are the only other species that can do this) and forwards; they can even copulate in the air while hovering, like the kestrels do. Their wings have a rhythm of 20-30 beats per second. A new study published in the Journal of the Royal Society Interface has revealed the secret of the stunts of the dragonflies: it's all in their ability to move their four wings independently. Most insects use their wings like a single pair. In beetles and bugs, the anterior wings, resembling a crust, are called elytra and they do not beat the air, being just used for protection. Mosquitoes and flies have just one pair of wings (not two), the second having been turned into two organs that detect altitude and acceleration, allowing the insect to adapt permanently to the parameters of the flight. Others insects, like butterflies and bees, synchronize the motion of their wings, while special hooks anchor the anterior and posterior wings on one side. Dragonflies and damselflies are different: their specific musculature allows them to move each of their four wings independently. Computer modeling has revealed that this type of flapping decreases the amount of generated lift. To verify these computer models, James Usherwood, a biologist at the Royal Veterinary College in London, and Fritz-Olaf Lehmann, a biologist at the University of Ulm in Germany, developed a robot mimicking a dragonfly. The robot was soaked in mineral oil containing air bubbles, which permitted to monitor the movement of the liquid around the moving wings. Sensors placed at the base of the robot's wings registered lift and drag forces, and the gathered data allowed to determine the aerodynamic efficiency of the robot.The robot revealed that flapping four wings actually generated more lift for the same amount of spent energy compared to only two wings. The hind wings, flapping just 25% of a wing beat ahead of the front wings, could catch the rush of air generated by the front wings and generate lift with 22% less energy than in the case of a two-winged system. Synchronized flapping too was beneficial: in this case, the robot dragonfly was able to lift off and accelerate better than when using just two wings or four out-of-sync wings. "Engineers may be able to apply these findings to building the next generation of flapping micro air vehicles," said Lehmann."Scientists need to validate the findings in living insects. The main difficulty facing the designers of micro air vehicles is that battery life limits how long the devices stay aloft, so any tips or tricks which enhance aerodynamic efficiency will be warmly welcomed," Richard Bomphrey, a biologist at the University of Oxford in the U.K., told ScienceNow.