Biomimetic Wings for Enhanced Aircraft Performance

Hoye Pacholek, Sophie (School: Henry Wise Wood High School)

In recent years, small unmanned aerial vehicles (i.e., drones) have begun to emerge as an important tool in many industries, particularly in disaster relief. However, smaller drones that lack expansive fuel storage or lavish budgets are struggling to become reliable, maneuverable, and efficient. This research focused on the creation of a wing design based on avian and whale characteristics, with the goal to improve upon high-lift and high-manoeuvrability flight. Five wings were designed and subsequently tested in a wind tunnel: a ‘control’ wing based on a standard airfoil design, a cambered avian airfoil, an avian airfoil with a blended winglet designed with raptor wing characteristics, a standard airfoil with whale-inspired tubercles, and a wing with both an avian airfoil and whale-inspired tubercles – modelled as sinusoidal protrusions on the leading edge of the wing. Experimentation found that the incorporation of an avian airfoil and tubercles resulted in notable improvements in lift, stall, maneuverability and up to two times greater efficiency at optimal angles of attack. Clearly, biomimicry is a promising field for modifying engineering systems such as unmanned aerial vehicles. The advantages of improved drone design can include reduced human exposure to danger, increased cost-effectiveness, increased fuel efficiency, and greater deployability in changing environments.

Awards Won: