INSIDE JEB

Coil tweaks give flying snakes a lift

Weaving through the sky, flying snakes more closely resemble their slithering terrestrial cousins than a penetrating javelin, swaying from side to side as they scribe the letter S in the air. To generate lift, the airborne reptiles splay their ribs, transforming their cylindrical body into a triangular cross-section 'to use their entire body as a wing', says Farid Jafari from Grand Valley State University, USA. However, he and colleagues Jake Socha and Roderick LaFoy from Virginia Tech, USA, and Pavlos Vlachos from Purdue University, USA, also wondered whether the sinuous shape mapped by the snakes' bodies may help them to generate additional lift. The trailing wings of dragonflies often benefit from a boost when stacked in the preceding wing's wake; might the rear section of an airborne snake's body tucked behind the head when in an S-shape also increase lift in particular configurations? As the snaking animals' posture can by simplified into a pair of parallel aerofoils, one placed behind the other, Jafari decided to tweak the distance between the aerofoils and their stagger, while also adjusting their tilt, to find out which postures could help snakes to boost their lift.

After testing 192 different aerofoil configurations – some of which the snakes adopt with ease while others are physically impossible – in a water tank, Jafari, LaFoy and Daniel Holden (Virginia Tech, USA) found that the snakes seemed to generate the most additional lift when the pair of aerofoils were tucked close together, although Jafari is unsure how often these beneficial close coils are adopted in practice. However, the snakes lost the benefit as the rear aerofoil fell too low beneath the one in front. In addition, when he altered the tilt of both aerofoils, the pair generated the most lift when rotated by 20 deg and 30 deg, respectively.

Visualising the water flowing over the two aerofoils when they were slightly staggered – one below the other –the team often saw the rear aerofoil being sucked upward by the wake of the preceding aerofoil, especially when the coils were staggered a little, 6 body widths apart, with the forward coil tilted a little (30 deg). 'These cases were important because they were similar to the most probable posture of flying snakes', says Jafari. However, when the team compared the amount of lift generated by the lab aerofoils with that produced by genuine snakes, the pairs of aerofoils never performed quite as well, even when they most closely mimicked the postures of the airborne reptiles.

'Generalising our findings to flying snakes suggests that they can achieve relatively large changes in the overall lift-to-drag ratio with slight adjustments of their posture', says Jafari. The snakes may be able to dramatically adjust their flight by subtly altering the relative positions of their coils to generate a little extra lift.

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