How wings really work

January 25 2012

(PhysOrg.com) -- A 1-minute video released by the University of Cambridge sets the record straight on a much misunderstood concept – how wings lift.

It's one of the most tenacious myths in physics and it frustrates aerodynamicists the world over. Now, University of Cambridge's Professor Holger Babinsky has created a 1-minute video that he hopes will finally lay to rest a commonly used yet misleading explanation of how wings lift.

"A wing lifts when the air pressure above it is lowered. It's often said that this happens because the airflow moving over the top, curved surface has a longer distance to travel and needs to go faster to have the same transit time as the air travelling along the lower, flat surface. But this is wrong," he explained. "I don't know when the explanation first surfaced but it's been around for decades. You find it taught in textbooks, explained on television and even described in aircraft manuals for pilots. In the worst case, it can lead to a fundamental misunderstanding of some of the most important principles of aerodynamics."

To show that this common explanation is wrong, Babinsky filmed pulses of smoke flowing around an aerofoil (the shape of a wing in cross-section). When the video is paused, it's clear that the transit times above and below the wing are not equal: the air moves faster over the top surface and has already gone past the end of the wing by the time the flow below the aerofoil reaches the end of the lower surface.

“What actually causes lift is introducing a shape into the airflow, which curves the streamlines and introduces pressure changes – lower pressure on the upper surface and higher pressure on the lower surface,” clarified Babinsky, from the Department of Engineering. “This is why a flat surface like a sail is able to cause lift – here the distance on each side is the same but it is slightly curved when it is rigged and so it acts as an aerofoil. In other words, it’s the curvature that creates lift, not the distance.”

Babinsky is quick to stress that he is far from the only aerodynamicist who is frustrated by the perpetuation of the myth: colleagues have in the past expressed their concerns in print and online. Where he hopes his video will help debunk the myth once and for all is by providing a quick and visual demonstration to show that the most commonly used explanation cannot possibly be correct. The original video, created by Babinsky a few years ago using a wind tunnel, has now been re-edited in high quality with a voice-over in which he explains the phenomenon as it happens.

Babinsky’s research focuses on the fundamental aspects of aerodynamics as they relate to aircraft wings, Formula I racing cars, articulated lorries and wind turbines. One of his visions is to design a wing that will enable aircraft to fly faster and more efficiently. Using a massive wind tunnel within the Department of Engineering, Babinsky and his team have been modelling the shockwaves that are created on aircraft wings and that restrict the plane’s top speed.

The newly released video will support lectures Babinsky will be giving as part of a series of University of Cambridge Subject Masterclasses aimed at Year 12 school children: “It’s important to put out this video because when I give this lecture to school kids I start by giving the wrong explanation and asking who has heard it and every time 95% of the audience puts their hand up. Only a handful will know that it is wrong.”

Provided by University of Cambridge