Unmanned Flight by MALE in Africa

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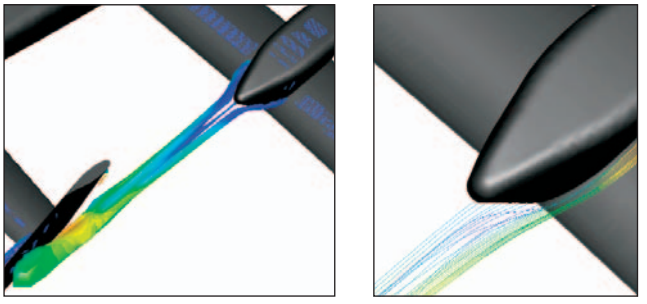
CFD HAS BECOME A TOOL that is increasingly being used in the initial design phases of aerospace products. At Denel Aerospace Systems, CFD plays an integral part in the airframe design phase of a product and it has proved its worth by highlighting several potential problems early on. One example where CFD is being used is the design of Bateleur, a medium-altitude-long-endurance (MALE) unmanned aerial vehicle (UAV). The design of Bateleur began in 2004. A mock-up of the UAV was unveiled at the African Aerospace and Defence Expo in September 2004 at the Waterkloof Air Force Base in South Africa.

As the name suggests, the UAV is primarily intended as a medium altitude, long endurance aerial platform for carrying surveillance and intelligence gathering payloads or payload combinations. Its roles and functions include real-time day and night surveillance; maritime, coastal, and border patrol; battlefield surveillance; and search and rescue operations. Its maximum cruise speed is approximately 250 km/h (approximately Mach 0.2).

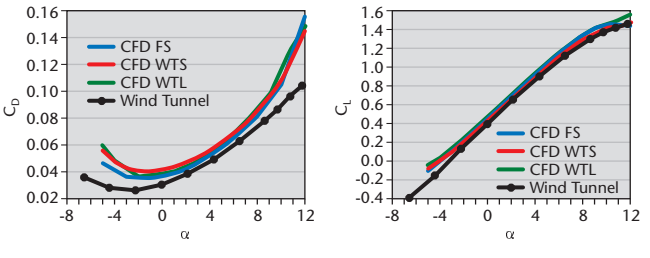
For the design of Bateleur, FLUENT has been used thus far to investigate the flow around the wheel-pods and the effect of the low Reynolds number in the wind tunnel on a scaled model of Bateleur. For the wheel pod analysis, path lines and iso-surfaces of turbulent viscosity were used to show that the rapidly changing cross-section of the wheel pod at the trailing edge of the wing caused flow separation to occur. As a result, the actual velocity magnitude of the flow around the pod in this region decelerated to well below its cruise speed.

For the scale model investigation, the values for lift and drag coefficients obtained from the wind tunnel results were compared to those obtained from the CFD simulations. The results from the laminar simulations correlated well with the wind tunnel measurements. However, the results obtained from the wind tunnel had to be scaled to account for Reynolds number effects.

These examples are only a small representation of what is expected from CFD for the future of the MALE UAV. It is expected that the role of CFD in the design phase will grow and that it will rise to meet the many challenging problems that arise. ■



An iso-surface of turbulent viscosity, colored by velocity magnitude (left) and pathlines colored by velocity magnitude (right) around the wheel pod



Comparison of lift (left) and drag (right) coefficients as a function of angle of attack, α, obtained from wind tunnel measurements and CFD calculations