SHOCK WAVE CHARACTERISATION THROUGH IN-FLIGHT OBSERVABLE SHADOWS

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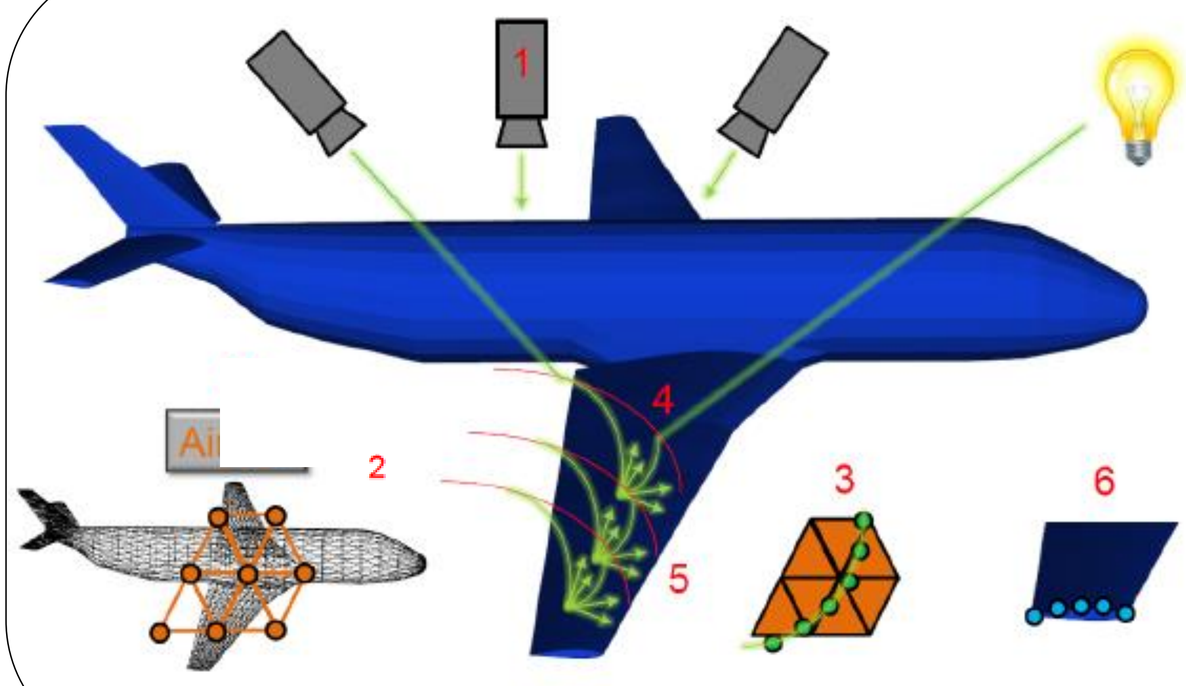
Sunlight impinging on an aircraft wing surface is affected by the shock waves that usually form and the corresponding disturbed flow field. This can lead to an observable series of bright and dark stripes, or shadow pattern, on the wing surface. The question arises: what can be inferred about the shock and the flow field from the observed shadow pattern?

Shadow pattern formed over the wing of a commercial airplane in transonic flight.



First objective: to develop an improved ray tracing algorithm to simulate the transmission, reflection and refraction of light in its propagation from its source through the flow (including shock waves) to viewing systems. Using CFD simulations this tool will then be used to assess the shadow pattern produced by shock waves at the wing of the aircraft and the surrounding inhomogeneous fluid flow all around it.

Early method was hampered by two points in the Runge-Kutta integration scheme falling into regions upstream and downstream of the thin shock. These regions have zero-gradient of the index-of-refraction and the local error was always below the preset tolerance. The integration proceeded without reduction of the step size, missing the discontinuity and, consequently, the light ray bending. New method incorporates adaptive discontinuity detection and refinement.