

Lift force for cylindrical and elliptical coandă aircraft design

ABSTRACT

Small aerial vehicles possess advantages in terms of size and accessibility in performing a variety of tasks. Presently, their design and performance is dependent on variations of conventional aerodynamic configurations (fixed- and rotary-wing). A disadvantage for these configurations is the aerodynamic potential between the mainstream airflow and the body surfaces are not fully utilized. To solve this issue, the Coandă effect is proposed whereby a high-velocity jet is blown tangentially over a curved surface to increase circulation and lift. Prior to the costly approach (experimental and numerical), an analytical formulation (via control volume analysis) to predict the aerodynamic Coandă lift force of the design concept is developed. This is an extended version of the existing mathematical formulations, capturing viscous flow effects. It is also pertinent for circular and elliptical-shaped designs. The results obtained show that the total lift force is dependent on the jet velocity, outflow angle, dimensions of the jet slot, the projected surface area, and the viscous effect. The approach has demonstrated how this modelling technique is effective in calculating the lift force for cylindrical and elliptical Coandă aircraft design.

Keyword : Coandă effect; Flow control; Aircraft design; Aerodynamic lift; Jet momentum