

Circulation control aircraft design: assessment on the channel-wing lift-thrust performance characteristics

ABSTRACT

Channel-wing has the ability to exceed the performance of conventional aircraft wing design; allowing for short take-off, overcome the needs for expensive conventional long runway setup and potential to decrease the aircraft running cost (e.g. flight duration, fuel usage). Assessment on the aerodynamic lift and propulsive thrust of three different sizes of the channel-wing design is carried out. The aim of the study is to provide an understanding of the channel-wing lift-thrust performance characteristics with the changes of the wing sizing (i.e. wing chord length). Fabrication of the channel-wing models was executed via 3D printer machine and the measured forces were analyzed using multiple load-cells and a microcomputer setup. All of the measurements are done in a controlled environment, and the channel-wings were tested at zero forward speed and at zero angles of attack. Indeed, the high speed rotating propeller mounted at the trailing edge of the wing generates a suction effect, reducing the pressure on the upper surface of the channel wing, producing lift. The results have shown that with a larger channel-wing size, the lift to thrust ratio can reach over 30%, however, when evaluating on the lift coefficient, the small channel-wing size is by far the most efficient. The amount of lift force generated and the reductions in the net thrust are found both dependents on the sizing of the channel-wing; longer wing chord promotes higher generations of lift, however, at the expense of some fraction of thrust.

Keyword: Channel-wing; Circulation control; Aerodynamic force; Flow control