Announcing the Final Examination of Brian Garrett for the degree of Master of Science

Time & Location: July 5, 2019 at 12:00 PM in Engineering 2 202A
Title: Fluid Flow Characteristics of a Co-Flow Fluidic Slot Jet Thrust Augmentation Propulsion System

The UAV industry is booming with investments in research and development on improving UAV systems in order to increase applications and reduce costs of the use of these machines. Current UAV machines are developed according to the quadcopter design. This design consists of a central body which houses the computer, wireless receivers, and other equipment connected to four arms which carry the rotary blades at the ends of each arm where the thrust is produced for flight. This design has some flaws; namely safety concerns and noise/vibration production both of which come from the rotary propulsion system. As such, a novel propulsion system using slip stream air passed through high performance slot jets is developed and optimized with the fluid characteristics analyzed in this research paper. This type of propulsion system is in current use in aircrafts with VTOL abilities and as such shows promise [24].

The test section for the experiment is developed using 3D printed ABS plastic airfoils modified with internal cavities where pressurized air is introduced and then expelled through slot jets on the pressure side of the airfoils. Entrainment process develop in the system with the use of slot jets introducing high momentum fluid into a quiescent fluid. As such shear layer mixing is a key fluid characteristic analyzed in the system. The three independent variables tested are slot jet velocities, confinement spacing, and angle of attack. Pitot probe testing was conducted to calculate thrust produced in the system and PIV analysis is used to characterize the two-dimensional flow aspects and to optimize the system. Slot jet velocities are seen to produce higher exiting velocities downstream in the system. Confinement spacing showed to cause a decrease in flow velocity and thrust as the spacing was decreased for high speed runs. For the most restricted setups, combined self-similar flow is also seen causing separation of the flow further upstream and increasing pressure drag. Angle of attack outwards showed the influence of coanda effects but also demonstrated the highest bulk fluid flow and angling inwards created combined fluid flow which as well increased pressure drag in the system. Highest velocity peaks are seen at zero angle of attack but minimal mixing leads to a reduction in thrust production. Pitot probe testing, and PIV analysis showed different optimized systems, but the fluid characteristics seen in the experiment show the potential for this proposed propulsion system to be a viable option for UAV systems in the future.

Major: Mechanical Engineering

Educational Career:
Bachelor’s of Mechanical/Environmental Engineering, BS, 2017, East Carolina University

Committee in Charge:
Kareem Ahmed, Chair, Mechanical & Aerospace Engineering
Samik Bhattacharya, Mechanical and Aerospace Engineering
Jayanta Kapat, Mechanical & Aerospace Engineering

Approved for distribution by Kareem Ahmed, Committee Chair, on June 17, 2019.

The public is welcome to attend.