Preface

Research and development in Unmanned Aerial Vehicles (UAVs) has witnessed unprecedented levels of growth during the last decade. Despite different points of view with respect to the specific definition—i.e., Unmanned Aircraft System (UAS), Remotely Piloted Aircraft System (RPAS), or the widely misused term *drones*—unmanned aviation applications now exceed by far the military and battlefield domains, reaching and penetrating civilian and public domains like precision agriculture, environmental monitoring, infrastructure monitoring and inspection, emergency response and management, law enforcement, cartography, and real estate, to name but a few such applications. In addition, major emphasis is given to the orderly integration of unmanned aviation into the national airspace, albeit challenges and different approaches to the process from different stakeholders. It is true that organizations like the Federal Aviation Administration (FAA), International Civil Aviation Organization (ICAO), European Aviation Safety Agency (EASA), and even NATO are working towards establishing a common framework and roadmap to facilitate timely integration of all classes of unmanned aviation into the national airspace system. On the other hand, far-fetched ideas like Personal Air Vehicles (PAVs) have started to surface, at least conceptually, and this allows for a whole new spectrum of aircraft designs, to say the least.

This research monograph presents a comprehensive methodology to design and test experimentally a Circulation Control Unmanned Air Vehicle (UC^{2}AV). The underlying concept and idea is to implement Circulation Control (CC), which is an active flow control method used to produce increased lift over the traditional systems (flaps, slats, etc…) currently in use, to design fixed-wing aircraft exhibiting enhanced aerodynamic performance in terms of reduced runway for takeoff and landing, increased effective payload and delayed stall. CC blowing is effective enabling the wing to achieve high lift-to-drag ratios and high lift augmentation during takeoff, and wind tunnel results indicate that upper slot blowing using CC can be effective for lift enhancement even at low blowing rates.

Design centers on building and integrating with the aircraft fuselage a complete circulation control system, composed of *Coandă*-based Circulation Control Wings (CCWs), an Air Supply Unit (ASU), and Air Delivery System (ADS), along with the corresponding instrumentation and controls. The testbed is a small-scale, Class I fixed-wing aircraft, which presents design challenges due to size, space, and payload limitations. The discussed methodology goes beyond the current state of the art by demonstrating feasibility of CC as applied to small-scale UAVs. 2-D and 3-D wind tunnel tests at Mach numbers of 0.03, with momentum coefficients of blowing (C_μ) ranging from 0.0 to 0.3 are conducted and through flight testing, it is confirmed that CC, when applied to small-scale UAVs, results in significant runway reduction up to 54%. The proposed methodology may be directly enhanced and used on commercial airliners and cargo planes.

The research monograph is suitable for scientists and engineers and graduate students conducting research in the area of unmanned aviation. Prerequisite knowledge to read the book is fundamental knowledge of aerodynamics, while knowledge of feedback control systems and classical robotics will also help.

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