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# SIZING AND PERFORMANCE ESTIMATION OF THE PAYLOAD LIFTING WITH A CIRCLING SINGLE FIXED-WING TETHERED AIRCRAFT

Maxime Doguet*, David Rancourt
Department of Mechanical Engineering, Université de Sherbrooke, Sherbrooke, Canada
*maxime.doguet@usherbrooke.ca

## ABSTRACT

Interest in transporting payload by air has grown significantly since the 1950s with the necessity of lifting heavy infrastructures such as power lines or reaching remote locations for mining exploitation. Nowadays, vertical take-off and landing (VTOL) aircraft fulfil some of these missions. Despite great improvements over the last two decades with the democratization of tiltrotor aircraft, these advances focus on improving the high-speed capabilities, not their hover efficiencies. Moreover, no rotorcraft can reach 60,000 ft to observe a suspicious balloon due to their limited ceiling, while a light fixed-wing aircraft can and even loiter around.

As an alternative to conventional rotorcraft to lift payloads by air, concepts with one or more fixed-wing tethered aircraft have been proposed since the early 1930s but until the mid-2010s, manned aircraft were considered, being the main limitation of this technology due to the required repetitive and precise flight path. Although a multi-aircraft concept can improve the stability of the payload, some control issues increase the risk of the development of the technology. To remove these control issues, a concept using a single fixed-wing tethered aircraft with an active control system on the tether tip is proposed.

This study presents a performance exploration of this concept based on one off the shelf aircraft: the Pipistrel Sinus. The performance is studied through two values: the power required by the aircraft and the position control system. The article will present the optimisation of the overall power requirement with respect to the tether length, the turn radius, and the speed of the aircraft. The effects of the payload mass and the altitude are also evaluated in this work. Simulation results show that such a system could provide a power efficiency for a given load that is at least two times higher than that of a conventional rotorcraft. It is also demonstrated that the non-optimized system proposed here could hover at 15,000 ft while no conventional rotorcraft designed for payload lifting can.