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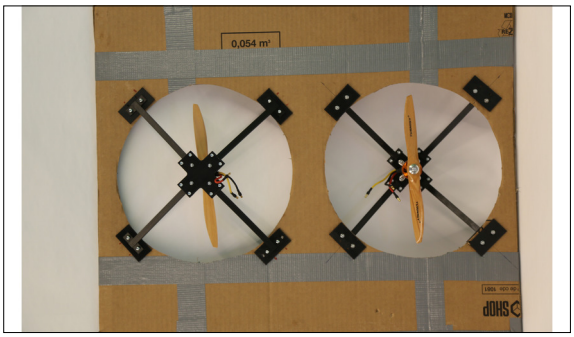
Subject Area	Energy and Environmental Technology

Helvetic Solar Airship HSaiR

Identification and optimization of floating dynamics of the HSaiR

Testride of HSaiR



New yaw propeller concept

Components of HSaiR version 1

Introduction: The HSaiR (Helvetic Solar Airship) is an airship developed by HSR (Hochschule für Technik Rapperswil). The long term goal of this project is to realize an autonomous, solar-powered airship that can stay in the air for as long as possible with optimal efficiency and optimized manoeuvrability. Therefore more knowledge and experience must be gained about the flight dynamics of the airship. The purpose of this semester thesis is to understand the dynamics, carry out further test rides and evaluate and optimize the manoeuvrability of the system by changing the yaw propeller concept.

Procedure / Result: The airship has a lot of potential for improvement.
The main propeller that produces the forward motion of the airship is located as a single unit at the very front, where approximately 30% of the generated thrust is lost due to momentum effects caused by distraction of the accelerated air on the envelope.
Due to an inefficient yaw propeller system, the manoeuvrability is weak. For a counter clockwise rotation it takes 50 s and a clockwise rotation was not even possible.
The lift that the airship generates does only allow an additional weight of 31 N to be added to. The maximal mass of the required solar modules is therefore 3.1 kg.

Solution: To increase the efficiency of the airship, a new propeller concept that is based on commercially used airships is recommended. If the single front propeller that generates the forward motion would be replaced with two propellers on the side of the airship, thrust loss due to momentum effects would be eliminated.
Furthermore, an additional rotational force could be generated by controlling each propeller independently. This concept allows smaller motors to be mounted with even a higher efficiency due to lower power consumption. Moreover vertical take-off and landing would be possible.
To increase the manoeuvrability a new yaw propeller concept was developed. It consists of one propeller for each rotational direction. Each propeller configuration generates 4 times the force of the existing single propeller and operates with the optimal setting. This system brings the rotating time down to 30 s for 360° clockwise as well as counter clockwise.
In order to further reduce the moment of inertia and mass, lighter components are recommended. The fin in which the yaw propellers are mounted should be made from composite materials. This measure could reduce the total mass by 0.5 kg.
For realizing an autonomous system, a flight recording system is needed providing all the necessary information such as current position, altitude and speed above ground. The PixHawk V2 Autopilot is a system that can offer all this data at an excellent price.