Thesis Project Portfolio

Solar-Powered Fixed-Wing Aircraft Design

(Technical Report)

Out of Time! An Overview of Time Infrastructure

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

The topics for both of my research papers concern the design of sociotechnical systems in a way that promotes stability and sustainability. The general problem I address is the fragility of structures when maintained without consideration for its social and technical components. When approaching both aircraft design and time infrastructure, the pressure to streamline these systems without the broader concern of security have led to significant environmental and social instability. My research asks how we can design systems that reflect these concerns.

The aerospace industry is increasingly charged by high fuel emissions, exacerbated by aviation infrastructure that typically do not account for sustainability. While aviation is a highly technical field, its effects with emissions and monolithic infrastructure contribute to deeply social problems such as global warming and lack of structural sustainability. This problem calls for alternative designs for aircraft that are renewable, reusable, and durable.

For the technical component, my team and I focused on designing a high-altitude, solar-powered fixed-wing aircraft to serve as a sustainable alternative to traditional satellite structures and short-lifespan unmanned aerial vehicles (UAVs). Our method was to split the design process into three components: aircraft structure, communications and stability, and propulsion systems. Each component was tested through simulations and benchtop tests in order to examine the feasibility of the aircraft design. By integrating solar energy systems in aerodynamic performance, my team and I explored how solar aircraft could maintain long-duration stratospheric flight. The research showed that, with the right balance between structural design and energy optimization, solar-powered aircraft could serve as a sustainable and reusable technology for data collection, communication, and earth observation.

My STS research defined time as infrastructure, a fundamental yet invisible network that weaves into nearly every aspect of life, from bureaucracy and finance to technical and social systems. Overlooking the design of time leads to significant inequities in capitalist societies, leading to unsustainable practices and inevitable failures. Using infrastructure theory, social theories on temporality and culture, and historical and contemporary case studies, I argue that time is not just a technical measurement but also a social resource. I propose a pluralistic approach to time, one that embraces both its measured and lived realities, to better account for the complexities and vulnerabilities of capitalist infrastructure.

Together, these projects show how infrastructures, whether built to sustain flight or to regulate time, are not neutral and are inherently shaped by cultural values. Further research should build on this integrated view by bridging technical innovation with social insight. Future aircraft design should prioritize systems that are not only optimized, but durable and modular, and focus on how they can be commercially implemented. Meanwhile, STS research could continue uncovering how infrastructures impose power and test applied frameworks that allow for more flexible systems.

For the technical portion of my research, I would like to thank my team, SPARC, for their dedication and collaboration throughout this project, as well as our technical advisor, Dr. Aldo Gargiulo, for his invaluable support. For the sociotechnical portion of my thesis, I am very thankful to Professor Wylie, whose encouragement helped shape this paper from the very beginning. Finally, I want to thank my family and friends for their unwavering belief and patience; whether right down the street or across continents, I could not have done without your support.