NASA ISGC: Demonstration of Prandtl-D Wing aircraft for agricultural monitoring

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Background

The overarching goal is to **execute process and business development initiatives inspired by patented technologies made available through the NASA Technology Transfer to University (T2U) program**. Through informal discussions with NASA, we have discovered that NASA has ~1500 patented technologies that have potential for high societal impact but are not directly being utilized by NASA. The T2U program thus serves as a conduit for transfer of these technologies directly to universities to facilitate product development and commercialization opportunities via licensing of the technology should a product market exist. As a result, a tremendous opportunity exists to leverage the T2U program to engage students in state-of-the-art innovation using already patented technologies, while at the same time integrating both engineering and entrepreneurship students into the product development and business planning processes.

Project Description

The objective of this project is to a) **finalize the design and operation of an unmanned aerial vehicle with a Prandtl-D wing design**, and b) **evaluate the potential for commercialization into a real-world application**. Recent advancements in aerodynamics, advanced materials, fluids analysis, and manufacturing processes, and miniaturization of electromechanical components have opened the possibility of designing and fabricating more efficient planes, unmanned aerial vehicles (UAVs), and micro-UAVs. Researchers are continuously exploring new ideas to improve UAV aerodynamic performance to improve their fuel economy, climb performance, and glide ratio. Recent innovations in wing design (Prandtl-D wing) from NASA's Armstrong Flight Research Center (AFRC) have led to new opportunities for designing more efficient UAVs. The Prandtl-D wing has a proverse yaw due to the existence of induced thrust near the wingtips. Among several other benefits, the Prandtl-D wing is expected to have reduced adverse yaw when correcting for aircraft roll, improved fuel efficiency, and enable a more simplified aircraft structure due to its inherent tailless design.

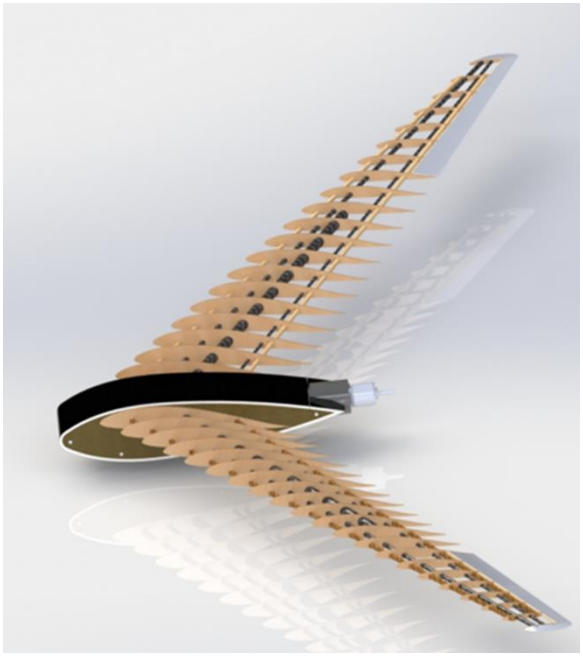

Figure 1. Rendering of Prandtl-D wing UAV designed and built for evaluation.

Last year, a capstone design team designed and built an ~12 ft wide UAV using the Prandtl-D wing design (Fig. 1). The conducted several test flights and gain valuable insights into the performance of the “flying wing.” Despite their great progress, more work is needed to optimize the design, controls, and operation of the aircraft. As a result, it is desired for this team to assess the prior team’s progress, identify any knowledge and capability gaps, and optimize the construction and performance of the aircraft via test flights.

Looking ahead, we are interested in exploring the potential for commercialization of the patented Prandtl-D wing technology on smaller UAVs. One potential application which is highly relevant in our region is in agricultural surveying. Another application could involve wildfire detection via deposition of wildfire sensors into forested areas. The charge for this team is to evaluate the feasibility for one of these applications. Activities may include design and prototyping of additional features on the aircraft, or a "paper study" using 3D modeling, battery life analysis, efficiency analysis, and cost estimations.

The available budget for student spending is ~$1,686 for additional prototyping, but the money must be spent within the first semester.

Engineering Disciplines: ME, EE, and CS