Warren J. Baker Endowment

for Excellence in Project-Based Learning

Robert D. Koob Endowment *for Student Success*

FINAL REPORT

Final reports will be published on the Cal Poly Digital Commons website (http://digitalcommons.calpoly.edu).

I. Project Mobius- A novel solar aircraft for long duration flight

II. Project Completion Date

1/1/2019

III. Student(s), Department(s), and Major(s)

(1) Lexy Aguirre, Aerospace Engineering

(2) Luke Bughman, Aerospace Engineering

(3) Trey Chambers, Aerospace Engineering

(4) Patrick Chizek, Aerospace Engineering

(5) Samuel Chung, Aerospace Engineering

(6) Hans Kehney, Aerospace Engineering

(7) Dani Lopez, Aerospace Engineering

(8) Claire Luce, Aerospace Engineering

(9) Paul Vankeppel, Aerospace Engineering

(10) Angela Wong, Aerospace Engineering

IV. Faculty Advisor and Department

Dr. Graham Doig, Aerospace Engineering

V. Cooperating Industry, Agency, Non-Profit, or University Organization(s)

(1) Cal Poly Prototype Vehicles Lab (PROVE Lab) - non-profit IRA at Cal Poly, loaned tools/equipment such as tools used to fiberglass
(2) Aerospace Student Fee Committee- providing funds to purchase the rolls of fiberglass

VI. Executive Summary

The goal of Project Mobius is to create a long endurance solar aircraft that utilizes the design concept of the boxed-wing or joined-wing. The joined-wing would provide the same amount of solar and lifting wing area as a high aspect ratio traditional wing, but it would more structurally sound. Over the past year, three different variants of Mobius have been designed and built. The MkI was the Radian XL Gilder, provided by our advisor Dr. Doig, with integrated solar cells on the wing. The MkII was our first wing, built by our team, made from balsa ribs, 3D printed parts, and a carbon spar. The MkII had many successful flights in the spring of 2018 at the Cal Poly Aerospace Experimental Flight Range (EFR). The MkII supported our design choice for the solar cell incorporation, but unfortunately, there was a crash,

and the wing was damaged. The MkIII was a completely new aircraft built entirely by the team. A new foam and film composite wing was manufactured and attached to a built up fiberglass pod. The MkIII is a successful design, but in order to incorporate more composite materials, the MkIII will be outfitted with an entirely new composite wing made from fiberglass and balsa wood. The long endurance flight of the MkIII will occur in the spring when there are more hours of sunlight. The MkIV will be a joined-wing solar aircraft, using the design choices of the MkIII composite wing process with batteries on the aircraft to allow for a 24-hour solar flight.

VII. Major Accomplishments

(1) Established the process to encapsulate the solar cells and properly integrate them into the electrical system of the aircraft.
(2) Established the process to create a composite wing out of fiber glass.
(3) Created multiple aircrafts that are able to fly on solar power.

The advisor, Dr. Doig, created multiple videos demonstrating the accomplishments of Mobius:

MkII (without solar): https://www.youtube.com/watch?v=2Sh1K1IJoF4

MkII (with solar): https://www.youtube.com/watch?v=2Sh1K1IJoF4

MkIII: https://www.youtube.com/watch?v=6fcZh5iHgAs&feature=youtu.be

VIII. Expenditure of Funds

The Baker-Koob grant funds were used to purchase the materials needed to build the different variants of Mobius.

A soldering station, wiring, MPPT (Maximum Power Point Tracking) charge controllers, servos, and other electrical components for the aircrafts were purchased. The funds were used to purchase the motor and propeller of the MKIII. The carbon fiber tail boom and wing spars were purchased as the structural component of the aircrafts. The screen and receiver were purchased for the aid of flying of the aircrafts.

The fiberglass and transmitter were funded by a grant made by the Aerospace Engineering Department's Student Fee Committee.

IX. Impact on Student Learning

There was a total of 10 aerospace students working on Project Mobius. All the variants of Mobius required many new skills in order to build the aircraft.

There was vital experience gained from learning how to wire the entire aircraft with solar cells incorporated. The research was done on how to connect the components effectively and what components to buy in order to have the most efficient power system.

Knowledge of different manufacturing processes was acquired such as 3D printing, laser cutting, soldering, making fiberglass layups, and vacuuming bagging fiberglass. For the Spring Quarter of 2018, three students took Project Mobius as an Aerospace Technical Elective and another student took is as an Aero 200 course. Collectively, the students have learned how to document their processes and created procedures so the manufacturing process can be replicated.

Three of the students on the project are female aerospace engineering underclassmen. Project Mobius is an inclusive environment that is encouraging female engineers to pursue their passions.

A few of the students who started on the project have graduated, but the other team members will continue to pursue the manufacturing of a joined-wing solar aircraft and the 24-hour flight goal in the summer of 2019.