Designing, Prototyping, and Testing Agricultural Drones

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This report details the second phase of a two-year project to design and test cheaper and more efficient aircraft to be used in seeding or fertilizing crops. Because aerial application is performed at extremely low altitudes to limit chemical spray, this study was designed to examine the feasibility of using a phenomenon known as wing-in-ground effect (WIG) in combination with hovercraft principles to result in a safer and more fuel-efficient aerial vehicle than currently used for “crop-dusting.” During the first phase of this study, background research was performed and programs like JavaFoil were used to simulate airfoil (wing) shapes and designs to find an efficient, stable wing (or wing pair). That phase began in 2012 and was successfully completed in January 2013 with the development of a stable tandem wing pair. The second phase involved designing, fabricating, and testing physical models in free air and a modified wind tunnel to confirm the virtual model data obtained during the first phase. Large (roughly two-feet wide) models were constructed using light-weight wood and carbon fiber, covered in epoxy-treated paper, and then repeatedly tested using a simple, yet consistent, elastic launch mechanism – other, smaller models were shaped from Styrofoam and tested in a wind tunnel with pressure sensors to measure the airflow across the wings. The constructed models are efficient, horizontally stable (not prone to flipping), and work as predicted in JavaFoil by statistically confirming the data previously gathered. Further testing is planned to be completed in the future, with the end goal of creating a quarter- or half-scale prototype.