Brigham Young University
AUVSI Capstone Team (Team 45)

Unmanned Ground Vehicle Drop Subsystem Description

ID	Rev.	Date	Description	Author	Checked By
GV-005	1.0	10-30-2018	Wrote concept description	Kameron Eves	Andrew Torgesen
GV-005	1.1	2-21-2019	Updated to reflect subsystem engineering	Jacob Willis	Brandon McBride

Introduction

This document gives a more detailed description of the selected concept for the UGV delivery system. The concept selected during concept development was a parachute with fins. After considering the added complexity of fins, and the small benefit they provide, we determined to simply use a parachute.

Description

The UGV is to be loaded within the aircraft. Upon a command from the flight controller system, a small hatch opens and the UGV falls out. The UGV is carried to the ground by a lightweight 36 inch nylon parachute, purchased from FruityChutes. The parachute is loaded onto the aircraft in a tube that allows the UGV to pull it out of the aircraft as it falls. This helps stop the tangling that can come from a folded parachute. To also prevent tangling, and to make for a more predictable drop, the parachute is folding according to GV-007. After exiting the aircraft the parachute will be opened by drag. This will slow down the system enough to allow the UGV to survive impact without damage. A visual depiction of our chosen system can be seen in Fig. 1.

An accurate landing is an important part of the competition, and is the key success measure governing the design of the UGV drop system. A hole in the top of the parachute improves the horizontal accuracy of the system by allowing a faster drop, but with more consistent aerodynamic effects. This hole is known in the industry as a spill hole because it allows the air to spill out of the center of the parachute. While this will not be enough to correct for large errors, it should be enough to ensure the system doesn't drift too randomly.

The algorithm for dropping objects from a UGV, as detailed in *Small Unmanned Aircraft: Theory and Practice* by Randy Beard and Tim McLain, is used to estimate the proper location to drop the UGV from in order to hit the target. This algorithm uses the wind and velocity of the aircraft to predict the best location to release the payload. A simulation of the drop, based on this algorithm is in GV-008. The parachute adds some complexity to the algorithm, since the surface area and coefficient of drag are not constant during the drop. In order to more accurately predict the landing location of the UGV, the drop will be repeatedly timed, and the time will be used by the algorithm. This will allow us better accuracy in our drop algorithm than using a model of how the parachute drops. It also necessitates a highly repeatable deployment. These were design goals, and were focused on in the development of GV-006 and GV-007.

Figure 1: Our parachute and simulated UGV as seen from the side.

Conclusion

Using the system described above, we are confidant in our ability to achieve a landing accuracy of within 25 feet. This is considered excellent performance in our key success measures and will give us 75% of the points possible in this portion of the competition.