Brigham Young University

AUVSI Capstone Team (Team 45)

Initial Concept Development

ID	Rev.	Date	Description	Author	Checked By
CD-0001	0.1	2018-10-23	Initial Draft	John Akagi	[CHECKED BY]

Idea	Description	Decision	Rationale
Skycrane	UGV is lowered on a rope from the UAV	Investigate	Would eliminate the need for most cushioning and control surfaces on the UGV
Fins	Fins are used to give minimal control to a fast falling UGV	Investigate	Would be smaller than full glider wings but still allow decent control
Glider	Unpowered aircraft is used to control the falling UGV	Investigate	Would likely provide the greatest amount to control
Parasail	A controllable parachute is used to steer the UGV	Dropped	Difficult and unknown controls
Control Grids	Similar to SpaceX, grids are used to steer the descent of the UGV	Dropped	Too complex for this application
Magnus Effect	Spin the wheels of the UGV in the air to generate lift and control UGV attitude	Modify	Could be used in conjunction with other methods but unlikely to have much effect by itself
Autogyro	Unpowered helicopter rotors are used to slow descent and blades can be tilted to control the drop	Dropped	Mechanism was considered too complex
Bounce	UGV uses some elastic material under it to decrease the time of impact	Dropped	Bouncing would likely not reduce the impact forces to survivable levels
Airbag	An airbag is inflated just before lading to cushion the drop	Dropped	Needs precise measurements to determine when to inflate airbag, Airbag inflation mechanism is likely to require dangerous materials
Springs	Springs are placed under the UGV to absorb the energy from the drop	Modify	Could be used to reduce impact energy but unlikely to be able to dissipate all by itself
Counterweight	A large mass is ejected downwards just before impact in order to slow UGV descent	Dropped	Requires ejecting a large mass at high acceleration which is likely to be dangerous and impractical

Crumple Zone	Use a deformable material to break and absorb energy when UGV impacts ground	Modify	Could be used to reduce impact energy but unlikely to be able to dissipate all by itself
Balloons	Use balloons to increase drag and provide some lift	Dropped	Would be large and impractical to carry on board the UAV
Parachute	Use a parachute to slow the descent of the UGV	Investigate	Simplest idea and almost guaranteed to work
Seedpod	Attach a single propeller blade to the UGV which would cause the UGV to spin and slow its descent similar to how maple seeds work	Dropped	The UGV is likely too heavy to implement this properly
Nothing	Make the UGV as rugged as possible and drop it from the UAV with no slowing mechanism	Dropped	Any UGV that is rugged enough to survive a 100 ft drop would be too heavy and bulky to carry on the UAV
Low Drop	Drop below the minimum allowable flight level and drop the UGV from a lower altitude for increased survivability	Dropped	Would violate rules that state we must remain above a certain altitude

Table 1: Description of initial ideas and decisions made. "Dropped" indicates the idea was considered unfeasible, "Investigate" indicates the idea was studied further, "Modify" indicates the idea was considered usable in conjunction with another idea or ideas.

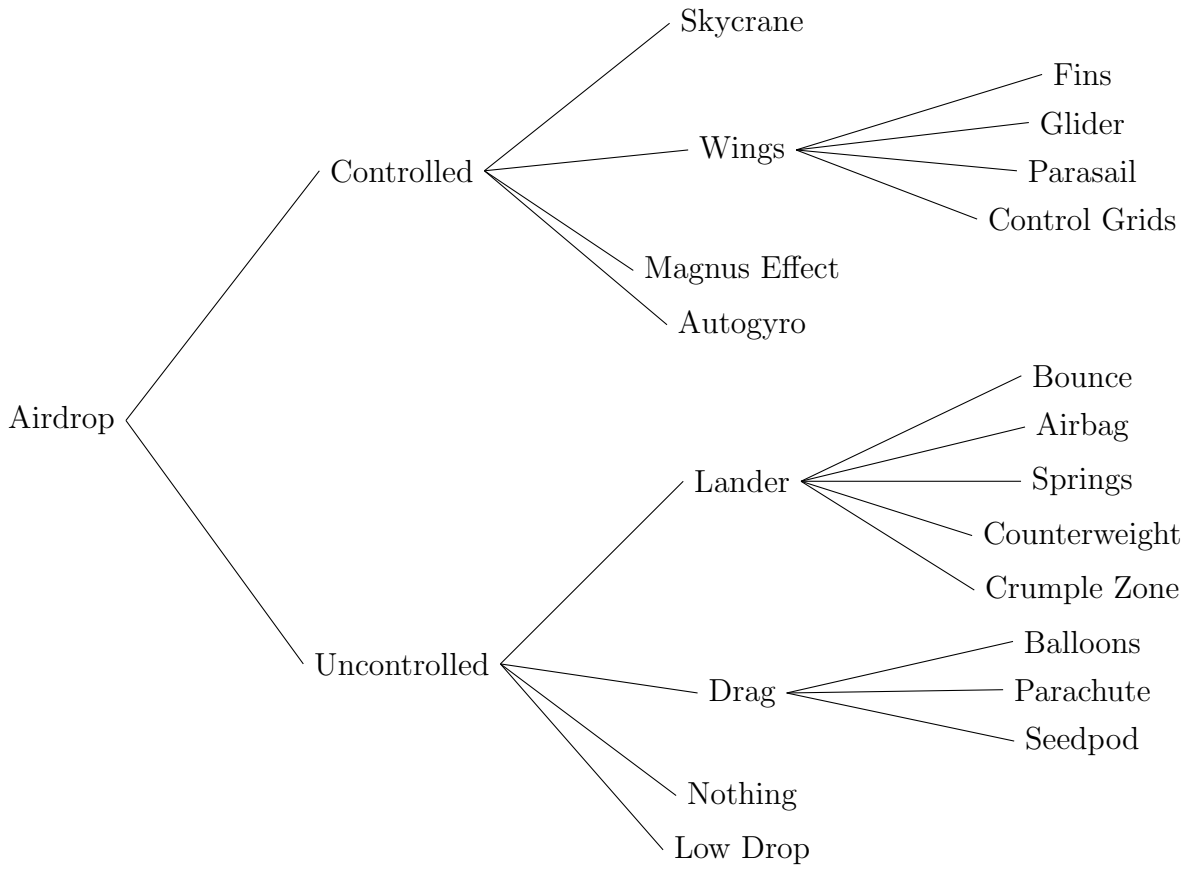

Figure 1: Concept development tree of the initial ideas generated for the payload delivery system.