TRANSPONDER LANDING SYSTEM AIRDROP

STUDENTS: BEA ELOISSA FLORES, MICHAEL MATHERNE, ERIC MUTSCHLER

Motivation

Advanced Navigation and Positioning Corporation (ANPC) makes transponder-based aircraft navigation systems which allow for landing in remote environments and places without traditional airport infrastructure. The Transponder Landing System (TLS) has recently been scaled down from a shipping container form factor to the Small Footprint Precision Approach Landing Capability (SF-PALC) design which makes the whole package able to fit on a 463L pallet- a MIL-STD pallet which is used for transport of items of a variety of shapes and sizes on many different military vehicles and aircraft. The goal of this project is to design the most feasible way to airdrop the TLS from an aircraft in flight, while ensuring the system lands in a target area undamaged, upright, and ready for mission performance.

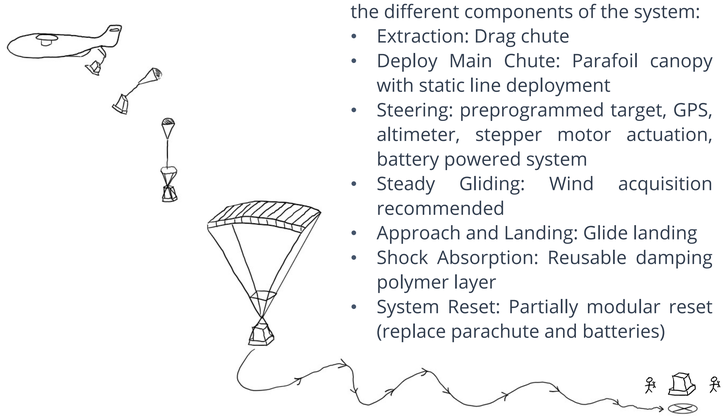
Requirements

Below are some of the requirements that were outlined by ANPC.
The system shall:

- Be transportable and airdropped via C-130H, C-5, and C-17 aircraft
- Not exceed 463L pallet requirements
- Be operable in austere environments around the world
- Be modular and be reusable
- Be installed by two people in under two man-hours using common hand tools
- Be able to land in a 100 sq. ft. area
- Reset for use in under two man-hours

[1]

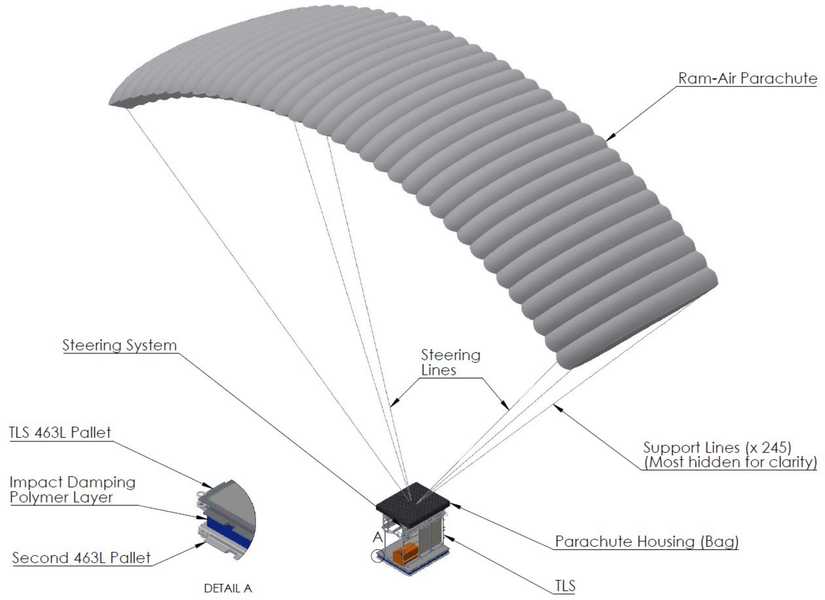
System Design



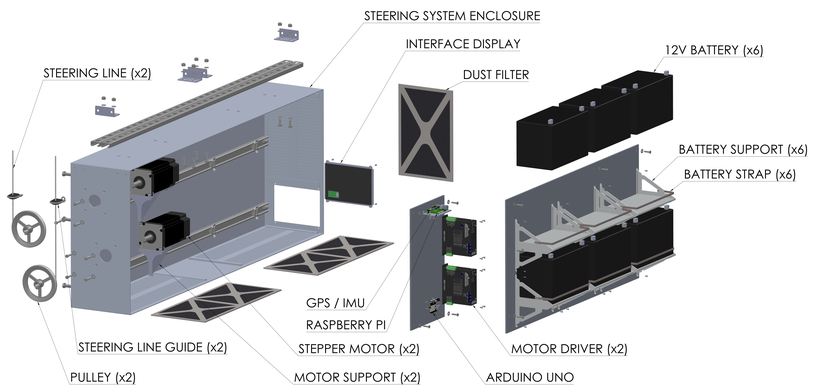
The following selections were made for the different components of the system:

- Extraction: Drag chute
- Deploy Main Chute: Parafoil canopy with static line deployment
- Steering: preprogrammed target, GPS, altimeter, stepper motor actuation, battery powered system
- Steady Gliding: Wind acquisition recommended
- Approach and Landing: Glide landing
- Shock Absorption: Reusable damping polymer layer
- System Reset: Partially modular reset (replace parachute and batteries)

Prototype Design

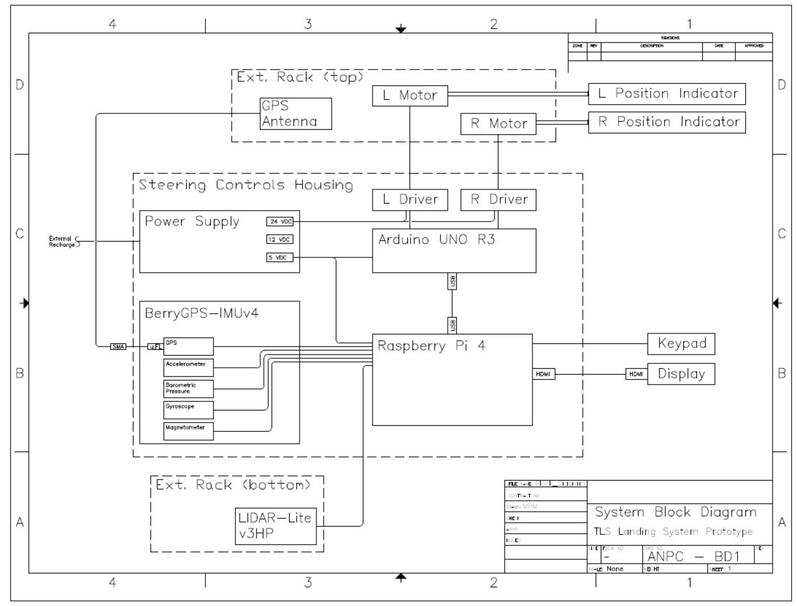


- The overall design of the TLS Airdrop heavily relies on accurately steering the entire payload to the target location
- The steering system is broken up into two subsystems: the sensor system for handling positioning data and the motor system for controlling actuation devices



Steering System

- Target location is preprogrammed and entered using the keypad on sensor system
- Sensors connected to Raspberry Pi 4 acquire real-time positioning data (i.e. GPS coordinates, altitude, and acceleration)
- Data received from sensors is sent to the motor system and is used to control the left and right stepper motors which are connected to the steering lines of the parachute



Conclusion

- Designed overall system to ensure that the TLS can be transported in specified aircraft
- Broke down steering system into two subsystems to make certain that the payload will land undamaged and upright at the accurate target location
- Implemented sensor system on Raspberry Pi 4 and motor system on Arduino Uno
- Connected sensor motor and motor system; used acquired location data to send signals to control left and right stepper motors

Future Work

- Further improvements to sensor system; integration of LIDAR-Lite v3HP (optical sensor), keypad, and interface display
- Implement all other components of the overall system design including parafoil canopy, drag chute, and reusable damping polymer layer

References

[1] *SF-PALC System Design*. 2021.

ELECTRICAL & COMPUTER ENGINEERING
UNIVERSITY of WASHINGTON

ADVISORS: PAYMAN ARABSHAHI, BLAKE HANNAFORD, DANIEL KING
INDUSTRY MENTORS: SAM LUEDLOFF, CONNOR WEBB, BLAKE WINNER
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