A Soft Drone For whole Body Perching
Hatvi Thakkar, Aerospace and Mechanical Engineering
Mentor: Wenlong Zhang, Associate Professor
Ira A. Fulton Schools of Engineering, Tempe

Research Statement

- The performance of multirotor aerial vehicles is limited by their endurance times when employed for surveillance missions.
- Instead of hovering, perching is used for drones to improve the endurance by placing the drone at a vantage point.
- Perching based drones offer low power to weight ratio and hence affect the flight durations adversely.
- The design of pneumatic actuator arms for full body perching of the drone is presented.

Design and Fabrication of pneumatic actuator

- Solidworks is used to create a 2D sketch for the seam, TPU, and elastic spandex fabric.
- All these fabric layers are further laser printed and then heat sealed at 315°F for 60 sec.
- Textile composite so obtained was sewed on the two side ends to obtain a pneumatic actuator pocket.
- TPU Actuator was fit inside the pneumatic actuator pocket such that the nozzle and pipe attached pops out of the holes on the actuator.
- Water bed test is performed on the TPU actuator to check for any leaks before adding it inside the pneumatic actuator pocket.
- The two remaining horizontal ends of pneumatic actuator are then sewed such that the sew doesn’t interfere with the TPU pockets.

Assembly of the full body perching drone

- Four pneumatic actuator arms are integrated with the DJI F330 Quadcopter top and bottom frame using the front holder support.
- To stabilize the drone during flight, the motor-propeller mount is integrated to the middle holder support.
- For autonomous control of the drone, a flight controller is integrated to the top support plate such that it connects with all the motor propeller mounts.
- The connector pipe is attached to the pressure pump to allow for the flow of compressed air.
- For the purpose of this project, the pressure control would be manually operated.

Testing and Evaluation

- Pressure test is conducted on the pneumatic actuator arm before assembly, to collect data points on the pressure applied and their respective change in angle.
- It was observed that at about 30 psi the pneumatic actuator overinflated and blasted.
- Optimization analysis can be further performed on the seam shape, size and shaping with design constraints on achieving 180° - 270° maximum bend and minimizing radial strain upon inflation.