A Novel Computer Simulation of a Deployable Parachute System with Aerial Detachment of the Cabin for Commercial Airplane Crashes, Year Two

Sandrapaty, Vivek (School: West Port High School)

This project aimed to determine the viability and effectiveness of a detachable airplane cabin equipped with a novel design of a parachute system in correcting the translational and rotational trajectory in an impending airplane crash. A computer simulation was designed in MATLAB using the differential equations governing the 6 degrees of freedom motion of the airplane cabin with the newly designed parachute system. Three proportional derivative controllers were incorporated in the design of the parachute system to control the reefing of the parachute which helped manipulate the rotational attitudes and minimize accelerations. The proportional derivative controllers were manually tuned and tested in MATLAB to achieve optimal performance. The simulation tested 6 different commercial airplane models with unique initial dynamic states. Results were analyzed to determine the safety of the landing velocities and midair accelerations. The angular orientations, velocities, and accelerations were also monitored to ensure proper parachute functionality and passenger safety. The ideal parachute size was calculated by the simulation and the drag on each parachute was determined to ensure that the paracords wouldn't break. The simulation output landing velocities below 6 m/s in the vertical axis, and below 0.5 m/s in the lateral axes. The maximum acceleration encounter was ~8 G which is less than the 15 G threshold considered dangerous. Lastly, structural analysis revealed that the tension experienced in the paracords never exceeded the tensile strength of the paracords and were safe. Therefore, it was concluded that the parachute system design was effective and viable.