Design of a protective cage for UAV

Introduction

Elios is a tolerant collision drone developed by Flyability. This drone is used to inspect closed and narrow structure like boilers. To resist to a collision during flight, the drone is composed of a decoupling system and a protective cage. This cage is composed of pentagon fixed together. These pentagons are made of carbon rods and of plastic connectors.

The objective of this project is to improve the performance of the cage so that the drone can withstand bigger impact. To do that, the energy absorbed by the cage during a collision needs to be maximized and its deformation minimized.

Tools

Two tools are available to test the performance of a cage:

1. Drop test setup
   This setup is used to simulate a collision. The height of drop and the cage orientation can easily be changed. Accelerometers are integrated inside the cage and allow to calculate the force and displacement of the center of mass.

2. Parametric model
   This model was developed by Ryan Giroud at the LMAF. It is a dynamic model of a drop test. It allows to change every parameter of the cage as the rods diameter and the rigidity of the connectors. This model is used to calculate the loading on the connector during an impact.

Methodology

1. Study of the global behavior of the cage.
2. Study of the loading on the connectors.
4. Study of the behavior of the connectors.
5. Cage strength analysis to determine what is the weakest element of the cage.
6. New design of the connectors

Connector design improvement

New designs of the central and lateral connectors are made to increase the absorbed energy of the cage by:

- controlling the buckling of the pentagon
- improving the fixation of the pentagon

One of the new design for the connector is the fit head design. It allows to improve the fixation of the pentagons and thus to increase the absorbed energy for a given deformation.

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