Design of Weight Efficient Quadcopter Structure

Student's Name	**K. Sudheer**	**ACD (FT-2012)**
Academic Supervisor(s)	Vinod K. Banthia and Pathan Ramjan Rashid	
Industrial Supervisor(s)		

K. Sudheer
sudheerncc@gmail.com
Ph. No: 0 96205 57108

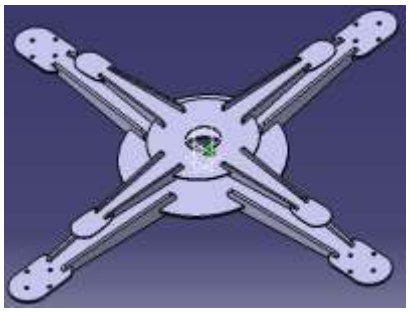
Keywords: Quadcopter, Unmanned Aerial Vehicles (UAVs), Structural Design

Abstract:

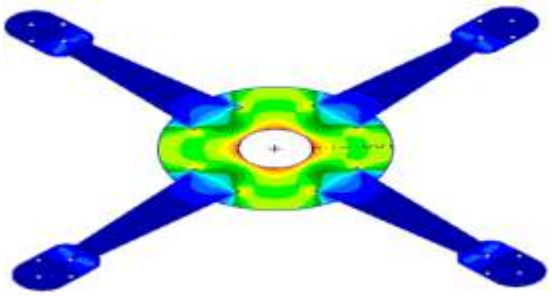
Multicopters are Unmanned Aerial Vehicles capable of vertical take-off and landing. Thrust and lift both provided by the same propellers, but mechanism is much simpler than helicopters because of two or more same direction of rotation. These lifting surfaces can be used to control the copter with varying their speeds; therefore the design of such vehicle is different than traditional design of fixed wings or helicopters. But improvement of fail-safe characteristics because of more than two rotors over helicopter, and distributed power usage are keeping these vehicles ahead of anything else in the world of UAVs for various applications. The structural efficiency of copter is directly proportional to payload capacity and higher endurance with higher capacity batteries. Current work was aimed at designing a weight efficient Quadcopter structure with available space for required electronics.

In the work, structural analysis of M S Ramaiah School of Advanced Studies (MSRSAS) - Quadcopter was carried out using Finite Element Analysis. Analysis of a reference design was carried out for different section thicknesses and materials available. Since constrains on flying objects are different than a grounded structure, the traditional method of structural analysis using finite element method has replaced to Inertia Relief Method (IRM) to consider inertia force generated in free flight. From the analysis critical areas of the structure and stiffness of the arms of the quadcopter were obtained. Weight of the payload and thrust generated by the motors were considered as loads. The experience of baseline has been used to analyse an alternate design for least weight with materials available in market.

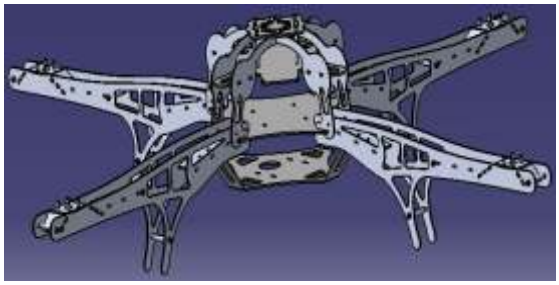
In this work, methodology to solve such structures has been established for further academic use. The obtained stress values for structures with various materials were less than the yield strength even at factor of safety of 9. Structural masses for Aluminium and Glass-Epoxy are 204 g and 135 g respectively for MSRSAS Micro Quadcopter. So, by using the Glass-Epoxy composite, structural mass was reduced by 36%, which will improve the endurance of the UAV.



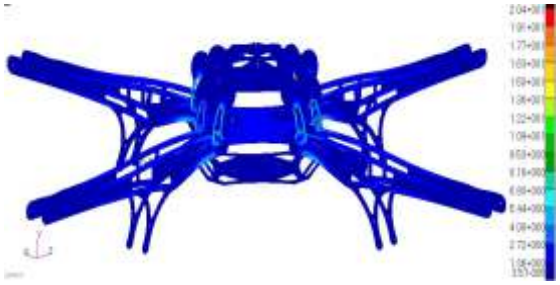
CAD model for baseline Qaudcopter



Stress plot for baseline Quadcopter



CAD model for the modified design



Stress plot for modified design