ISSN:1991-8178

Australian Journal of Basic and Applied Sciences

Journal home page: www.ajbasweb.com

Modelling and analysis of Quad copter Frame using Finite element analysis

[1]Raman Kumar Singh and [2]Umanath K

[1,2]*Department of Mechanical Engineering, Vel Tech High Tech Dr. R. R & Dr. S. R Engineering College, Chennai, India*

ARTICLE INFO

Article history:
Article Received 16 March 2015
Accepted 28 May 2015
Available online 22 June 2015

Keywords:

ABSTRACT

Man exploitation new technology fictitious varied UAV's and flying machines. These may be used for varied functions. Most of them are a unit in the main used for defense functions and therefore the rest area unit used even in domestic functions. A Quadrocopter, ordinarily known as quadrature, maybe a UAV (Unmanned Aerial Vehicle) that was propelled and upraised by four rotors. The battery was used as an influence supply to run the motors, thereby propellers. Modelling and Analyzing area unit the 2 necessary ineluctable steps in producing any part or structure. This paper concentrates on style and analysis of a Quadrocopter frame and propeller. The modelling was applied exploitation advanced computer code, named CATIA whereas the analysis of elements was done exploitation CATIAV5 version. The results obtained were compared with the varied properties of frame materials that tell the United States of America whether or not the planning created was safe or not.

© 2015 AENSI Publisher All rights reserved.

To Cite This Article: Raman Kumar Singh and Umanath K., Modelling and analysis of Quad copter Frame using Finite element analysis. ***Aust. J. Basic & Appl. Sci.,*** *9(11): 922-927, 2015*

INTRODUCTION

A multirotor or multicopter could be a rotorcraft with quite 2 motors. Multirotors usually use fixed-pitch blades, whose rotor pitch doesn't vary because the blades rotate; management of auto motion is achieved by varying the relative speed every of every rotor to alter the thrust and torsion created by each. Multicopters square measure the remote-controlled air vehicles in the main used for defense functions. Except for defense, there square measure many alternative uses of multicopters. The applications of multicopters are: Aerial photography, Crop dusting, Disaster response, accident investigation as advancement a multicopter may also be used for the transportation of persons.

2. CATIA V5 R20:

CATIA-which stands for laptop assisted Three-dimensional Interactive Application. It's the foremost powerful and wide used CAD (computer assisted design) package of its kind within the world. CATIA is that the sole answer capable of addressing the entire development method, from product constructs specification through product-in-service, during a totally integrated and associative manner. Supported associate open, scalable design, it facilitates true cooperative engineering across the multidisciplinary extended enterprise, as well as vogue and kind style, mechanical style and instrumentation and systems engineering, managing digital mock-ups, machining, analysis, and simulation. By enabling enterprises to utilize product style information and accelerate development cycles, CATIA helps corporations to speedup their responses to promote desires. The variety of CATIA capabilities permits it to be applied during a wide range of industries, like part, automotive, industrial machinery, electrical, physical, building, plant style, and goods, as well as style for such numerous merchandise as jewelry and wear.

3. Ansys Workbench Platform:

ANSYS, Inc. is an engineering simulation software (computer-aided engineering, or CAE) developer that is headquartered south of Pittsburgh in Canonsburg, Pennsylvania, United States. ANSYS offers a comprehensive range of engineering simulation solution sets, providing access to virtually any field of engineering simulation that a design process requires. The tools in ANSYS put a virtual product through a rigorous testing procedure such as crashed a car into a brick wall before it becomes a physical object. The ANSYS Workbench platform is the framework upon which the industry's broadest and deepest suite of advanced engineering simulation technology is built.

4. Frame Design Analysis:

Corresponding Author: Umanath K, Department of Mechanical Engineering, Vel Tech High Tech Dr. R. R & Dr. S. R Engineering College, Chennai, India
E-mail: umanath_me@rediffmail.com

Many analysis are created on quadrotor by worldwide researchers. Pounds *et al*. conferred basic dynamics analysis and management approaches through the look of a large-size quadrotor with total weight of 4kg and capable of lifting a 1kg payload that was deemed necessary for the computers and sensors of the time (Pounds, P., R. Mahony and P. Corke, 2010; Pounds, P. and R. Mahony, 2009). Bouabdallah and Siegwart accomplished spectacular ends up in management and state estimation with a quadcopter platform and a ground station. Image knowledge was sent to the bottom station, processed, and commands were transmitted back to the flying vehicle over a radio communications link (Samir Bouabdallah, R.S., 2005). Javier, Ahmad Shah Masoud and Bruce conferred the usability of quadcopter as safety review tool in industries. They centered on the construction trade. Their study projected the utilization of a quadcopter to fly over the development jobsite and supply the security manager with real time info concerning what's happening on the jobsite. additionally through the communication tools embedded in the quadcopter, safety manager will act directly with staff (Irizarry, J., *et al*., 2012). Tsubasa, Andrew, Ehrich, Eric, Paul and John projected the conception of non-destructive analysis of structures like bridges, where victimisation instrumentation mounted on a extremely stable and mobile UAV like quadcopter is a lot of economical and economical.

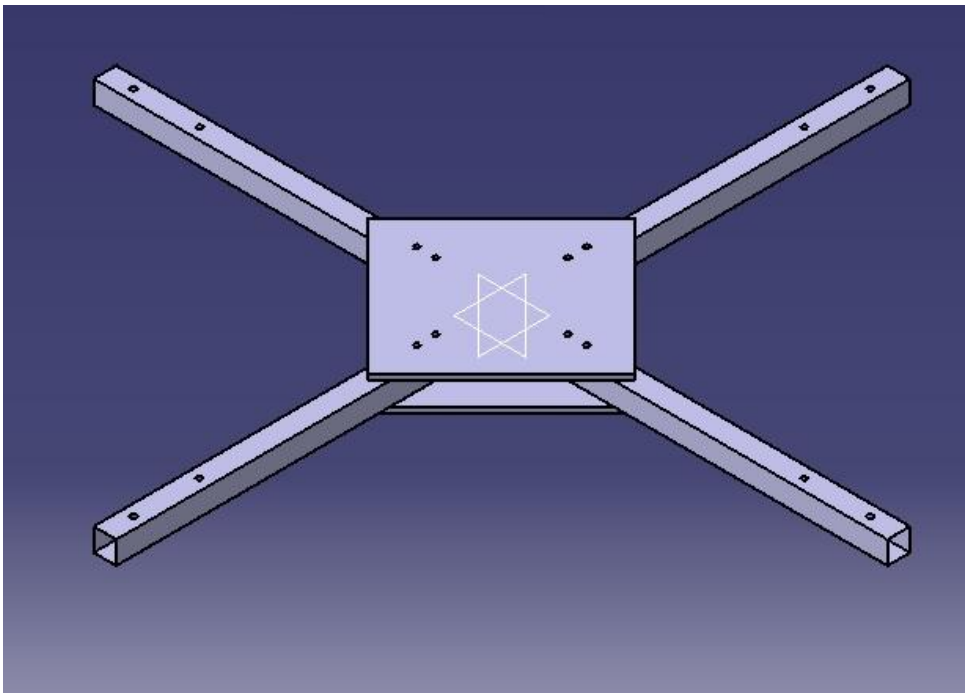

Fig. 1: Quad copter Frame

Table 1: Meshsize

Entity	Size
Nodes	11725
Elements	5986

Table 2: Element type

Connectivity	Statistics
TE10	5986 (100.00%)

Table 3: Material properties

Material	Aluminium
Young's modulus	7e+010N_m2
Poisson's ratio	0.346
Density	2710kg_m3
Coefficient of thermal expansion	2.36e-005_Kdeg
Yield strength	9.5e+007N_m2

5. Static Case:

The stability issue is addressed straightaway by the quadcopter concept; but there was a desire of a structure that was stiff, lightweight and fewer complicated (Iwai, T., *et al*., 2010). Recent case of victimisation quadcopter for civilian application is once moving ridge stuck the Fukushima atomic energy plant in Japan on the eleven th March, 2011.Dut to terribly unsafe conditions at the plant, Tokyo electrical power (TEPCO) used a US-made small aerial vehicle to photography the nuclear plant from higher than. The flying golem had already had already been employed by the United States military to find wayside bombs in Irak (Honig, Z., 2011).

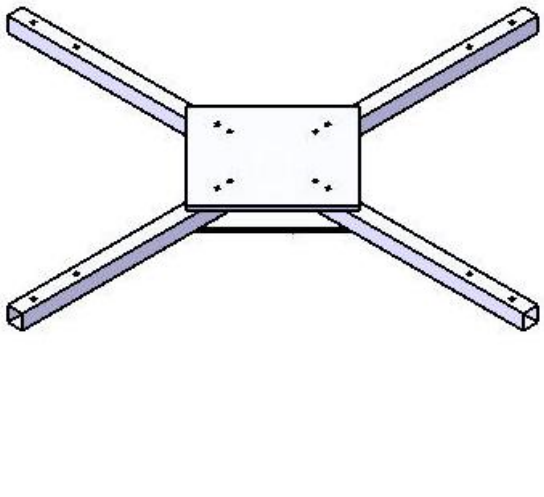

Fig. 2: Static case

6. Boundary Conditions:

The practical use of a quad copter was cited in New island to look at the front of the Roman Catholic Cathedral in Christ church that was broken within the twenty two February, 2011 earthquake (Zibreg, C., 2011). Universities associate degreed analysis establishments have started victimisation this quadcopter as an experimental platform in several researches such as autonomous police investigation and navigation (Faigl, J., *et al*., 2010), human-machine interaction (Ng, W.S., and E. Sharlin, 2011), and while a sport assistant by providing athletes with external representational process of their actions (Higuchi, K., *et al*., 2011). With bi-directional CAD connectivity, powerful highly-automated meshing, project-level update mechanism, pervasive parameter management and integrated optimization tools, the ANSYS Workbench platform delivers unprecedented productivity, enabling Simulation Driven Product Development (Hoffmann, G.M., *et al*., 2007; Huang, H., *et al*., 2009; CATIA; Jack Zecher and FereydoonDadkhah).

Table 4: Structure Computation

Number of nodes	11725
Number of elements	5986
Number of D.O.F.	35175
Number of Contact relations	0
Number of Kinematic relations	0
Parabolic tetrahedron	5986

Restraint Computation
Name: Restraints.1
Number of S.P.C: 1935

Fx	=	-1	.	448e-016	N
Fy	=	-6	.	469e-016	N
Fz	=	-6	.	822e+000	N
Mx	=	2	.	547e-010	Nxm
My	=	3	.	182e-009	Nxm
Mz	=	-1	.	221e-020	Nxm

Load Computation
Name: Loads.1
Applied load resultant:
Stiffness Computation

Number of lines	:	35175		
Number of coefficients	:	1243851		
Number of blocks	:	3		
Maximum number of coefficients per block	:	499950		
Total matrix size	:	14.37Mb		

7. Direct Method Computation:

Name: Static Case Solution.1
Restraint: Restraints.1
Load: Loads.1
Strain Energy : 7.816e-004 J
Equilibrium

Table 4: List of components

Components	Applied Forces	Reactions	Residual	Relative Magnitude Error
Fx (N)	-1.4475e-016	6.1863e-010	6.1863e-010	2.2623e-011
Fy (N)	-6.4690e-016	-6.7454e-009	-6.7454e-009	2.4667e-010
Fz (N)	-6.8218e+000	6.8218e+000	-1.8023e-007	6.5909e-009
Mx (Nxm)	2.5467e-010	-2.1370e-009	-1.8824e-009	3.2779e-010
My (Nxm)	3.1822e-009	-3.5967e-009	-4.1458e-010	7.2193e-011
Mz (Nxm)	-1.2209e-020	-1.6566e-010	-1.6566e-010	2.8847e-011

Static Case Solution.1 - Deformed mesh.2:

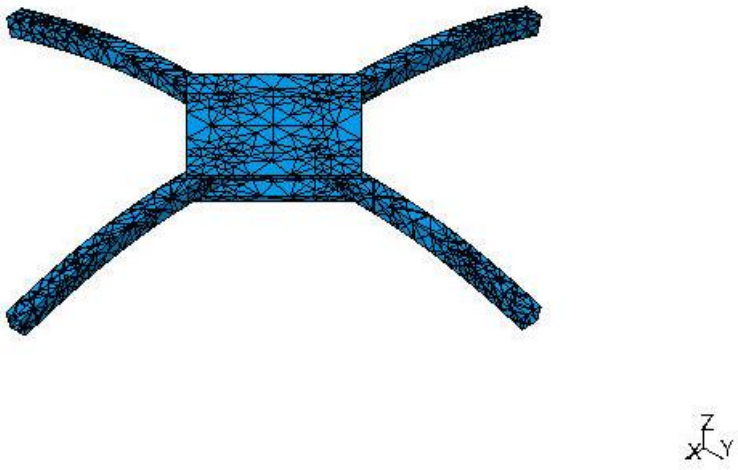

Fig. 2: Deformed mesh.2

On deformed mesh ---- On boundary ---- Over all the model

Static Case Solution.1 - Translational displacement vector.1:

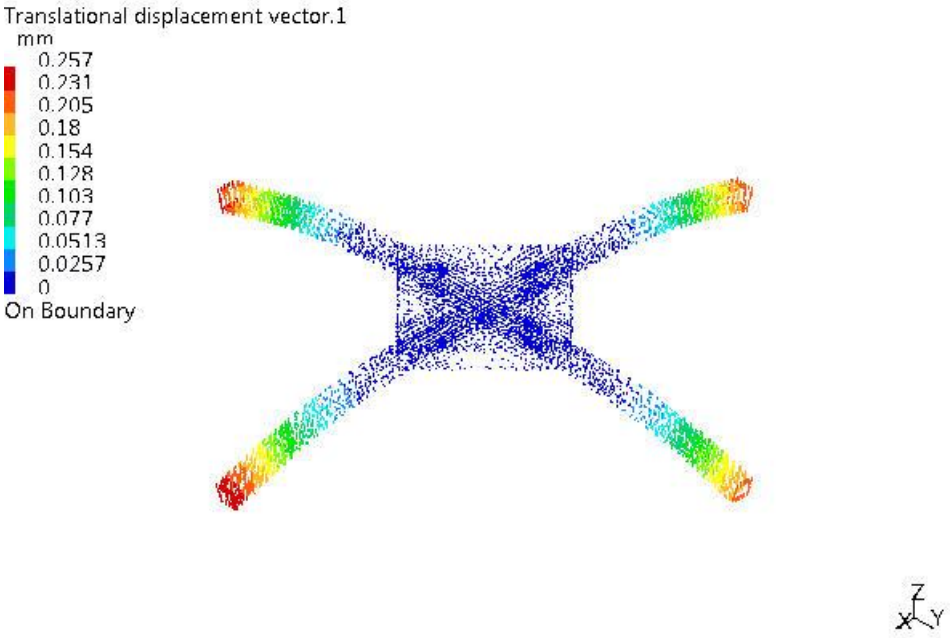

Fig. 6: Translational displacement vector.1

3D elements:: Components: : All

On deformed mesh ---- On boundary ---- Over all the model

Conclusion:

Analysis of the Frame is carried out using the Ansys workbench software and the results we have obtained are within the limits. AnsysWorkBench is the most efficient software for analyzing the structure. As the analysis shows it is safe to use the proposed design of the quadcopter.

REFRENCES

Aerodynamics for Engineering Students by E.L. Houghton, P.W. Carpenter, Butterworth-Heinemann Publication.

Fundamentals of Aerodynamics by John David Anderson, McGraw-Hill Publication.

Engineer's Aerodynamics by S. M. Yahya, John wiley & sons publication.

Pounds, P., R. Mahony and P. Corke, 2010. "Modelling and Control of a Large Quadrotor Robot," in Control Engineering Practice, 18: 691-699.

Pounds, P. and R. Mahony, 2009. "Design principles of large quadrotors for practical applications," in Proceedings of the IEEE International Conference on Robotics and Automation (ICRA), pp: 3265-3270.

Samir Bouabdallah, R.S., 2005. Pierpaolo Murrieri Autonomous Robots, 18.

Irizarry, J., M. Gheisari and B. Walker, 2012. "Usability assessment of drone technology as safety inspection tools" in Journal of Information Technology in Construction.

Iwai, T., A. Nunnikhoven, E. Rodger, E. Roggatz, P. Rose and J. Warning, 2010. "Quadcopter with collective and cyclic control" in Iowa State University, Project Design.

Honig, Z., 2011. "T-Hawk UAV enters Fukushima danger zone, returns with video." 6:48PM April 21, 2011, retrieved on April 22, 2011. http://www.engadget.com/2011/04/21/t-hawk-uaventers-fukushima-danger-zone-returns-with-video/.

Zibreg, C., 2011. "Awesome use of an iPad and the Parrot AR Drone." 8:10 June 15, 2011, retrieved on June 15, 2011. http://9to5mac.com/2011/06/15/awesome-use-of-an-ipad-and-the-parrot-ar-drone/.

Faigl, J., T. Krajnik, V. Vonasek and L. Preucil, 2010. "Surveillance planning with localization uncertainty for mobile robots." 3rd Israeli Conference on Robotic.

Ng, W.S., and E. Sharlin, 2011. "Collocated interaction with flying robots." Technical Report 2011-998-10, Department of Computer Science, University of Calgary, Calgary, Canada.

Higuchi, K., T. Shimada and J. Rekimoto, 2011. "Flying sports assistant: external visual imagery representation for sports training." 2nd Augmented Human International Conference, New York, NY, USA, ACM 7: 1-7:4.

Hoffmann, G.M., H. Huang, S.L. Waslander and C.J. Tomlin, 2007. "Quadrotor helicopter flight dynamics and control: Theory and experiment," Proceedings of the AIAA Guidance, Navigation and Control Conference and Exhibit.

Huang, H., G.M. Hoffmann, S.L. Waslander and C.J. Tomlin, 2009. "Aerodynamicsand control of autonomous quadrotor helicopters in aggressive maneuvering,"IEEE International Conference on Robotics and Automation, pp: 3277-3282.

CATIA V5 R20 by Sham Tickoo

Ansys workbench software release 12.0 tutorial by Jack Zecher and FereydoonDadkhah.