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Design and Analysis of Nose Landing Gear Lug Component of LCA Navy Aircraft

Ajit Bhosale[1], Sadiq Pachapuri[2],

[1]*Student, Dept. of Mechanical Engineering, KLE Dr. M. S. Sheshgiri College of Engg & Tech. Belagavi, Karnataka, India*
[2] *Professor, Dept. of Mechanical Engineering, KLE Dr. M. S. Sheshgiri College of Engg & Tech. Belagavi, Karnataka, India*

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Abstract – *In this paper we will deal with lug attachment component of nose landing gear of LCA navy aircraft. Lug attachment component helps landing gear to provide support and also in smooth taxing. Static and dynamic loads are acted on the lug attachment while landing. Hence both static and dynamic analysis is done by choosing suitable material. Weight optimization is also done.*

Key Words**:** Aircraft, Nose landing gear, Lug attachment Component, Geometric modelling, Stress analysis, Weight optimization.

1. INTRODUCTION

Aircraft is vehicle which is able to fly by gaining the support from the air. The components of the aircraft are fuselage, tail, which determines external structure but there are other internal parts which are also necessary from functional point of view. One of these parts is Lug attachment component of nose landing gear.

This paper deals with stress Static, Modal, and Dynamic analysis of lug attachment component of nose landing gear and also Weight optimization of the same.

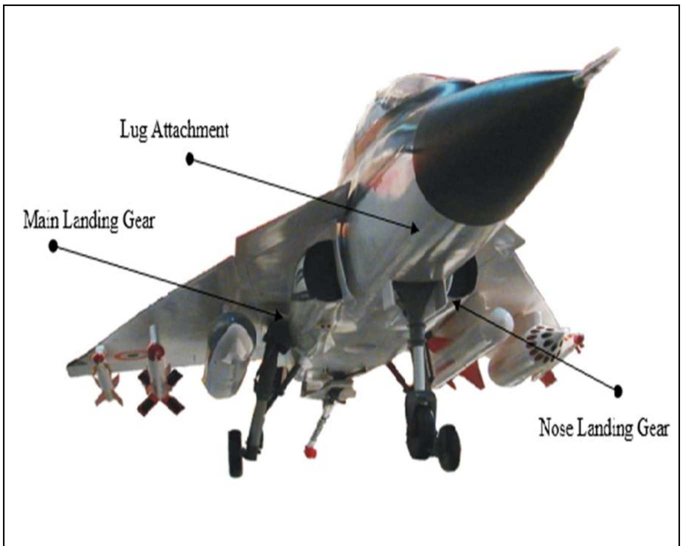
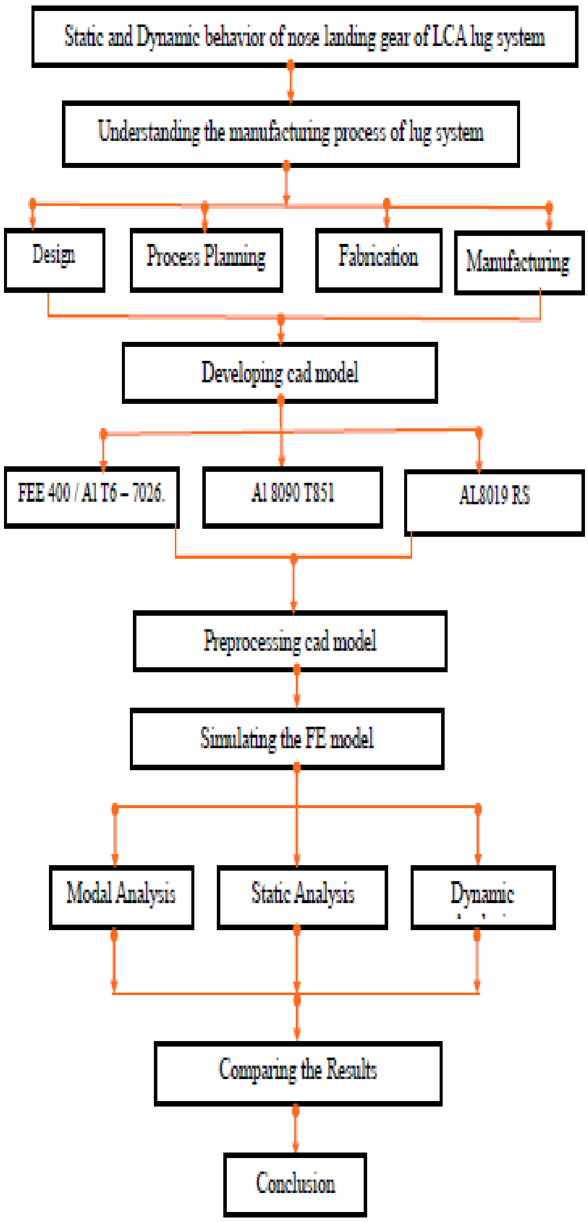


Fig 1.1 LCA Navy Aircraft

1.1 Methodology



2. LUG ATTACHMENT COMPONENT OF LCA NAVY AIRCRAFT

Since landing gears are subjected to very high compressive loads, there is need of strong back up structure at the fuselage of the LCA navy aircraft. The lug component structure successfully overcomes this problem and also acts as fuel floor as well. So we provide lug attachment component which is shown in figure 2.1.

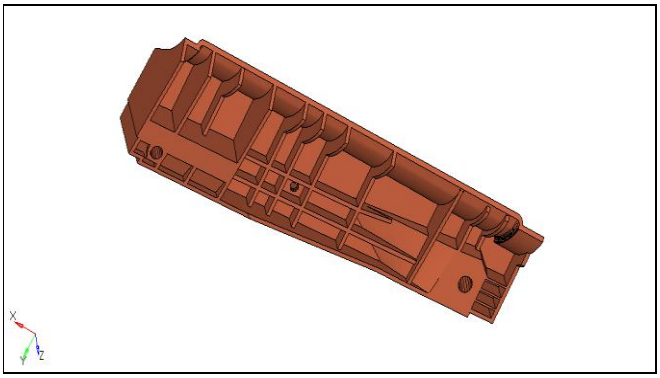


Fig.2.1 Lug attachment component of nose landing gear

2.1 Forces acting on Lug attachment Component

Following forces are acting on the lug attachment component under working condition.

Static Load = 25.9 KN
Dynamic Load = 47.79 KN
After considering factor of safety the total load acting will be,
Total vertical load= 112.5 KN

2.2 Materials and properties

Material properties are very important from the design point of view. Various materials can be selected from aluminium and its alloys. Few of them are listed in table 1.

Table -1: Material Properties

Materials	Density kg /m3	Young's Modulus MPa	Poisonous Ratio	Yield Strength
FEE 400/ Al T6 – 7026.	2.75	70,000	0.325	318
Al 8090 T851	2.25 kg/m3	80, 000	0.325	435
AL8019 Rapid Solidification	2.9 kg/m3	90, 000	0.32	380

3. STATIC ANALYSIS

Static analysis is necessary to find out structural displacements, forces, and stresses in the structure. The modelled view of static analysis is shown in fig 3.1.

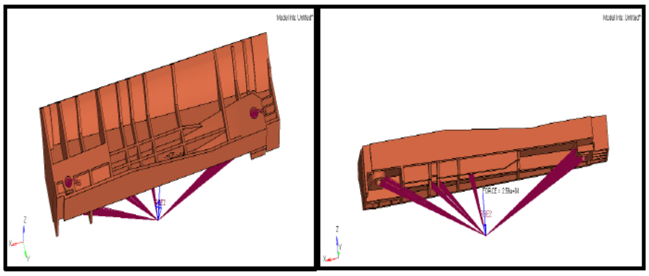


Fig.3.1 Modeled view of static analysis

4. MODAL ANALYSIS

In model two types of boundary conditions are applied. Free free modal analysis and constrained modal analysis. Modelled view of free free modal analysis is shown in figure 4.1

Fig.4.1 Modeled view of free free modal analysis

In constrained modal analysis, constraints are applied then simulations are carried out.

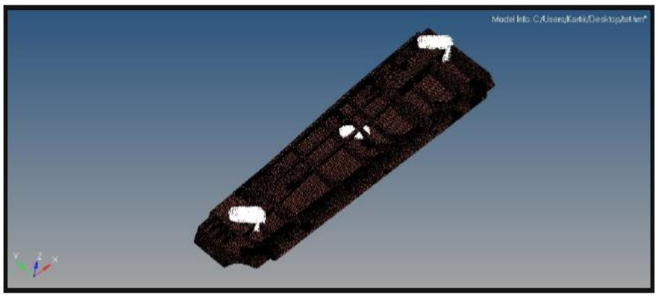


Fig.4.2 Modeled view of constrain modal analysis

5. DYNAMIC ANALYSIS

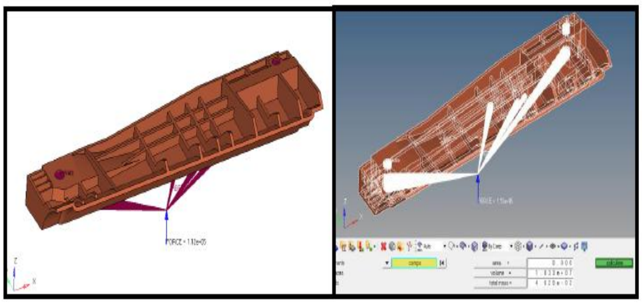


Fig.5.1 Modeled view of dynamic analysis

6. SIMULATION AND RESULTS

By simulating the model by static and modal analysis we will come to know that Al 8090 T851 is the best material since its weight is low and also Stress and deflections found to be almost same. So Simulation results of Al 8090 T851 is discussed here.

6.1 Static simulation of Al 8090 T851

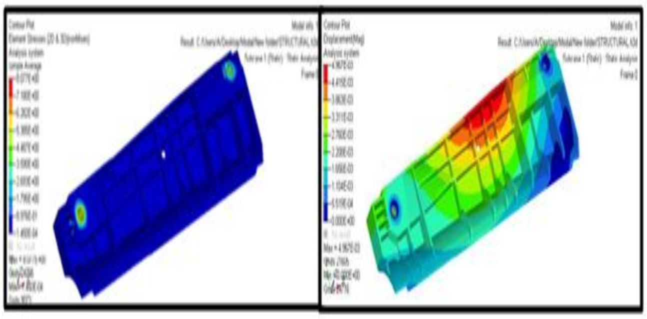


Fig.6.1 Vonmises Stress and Displacement

6.2 Modal simulation of Al 8090 T851

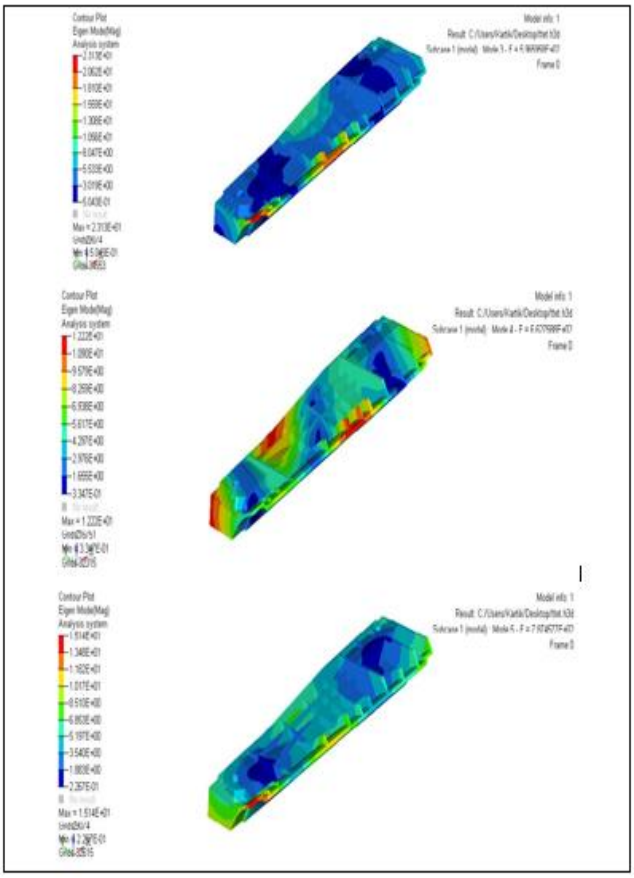


Fig.6.2 Modal Free-Free Analysis

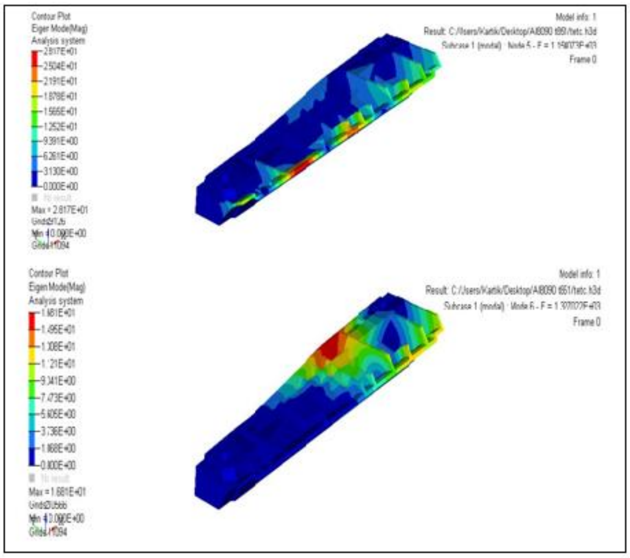


Fig.6.3 Modal constrain Analysis

6.1 Dynamic simulation of Al 8090 T851

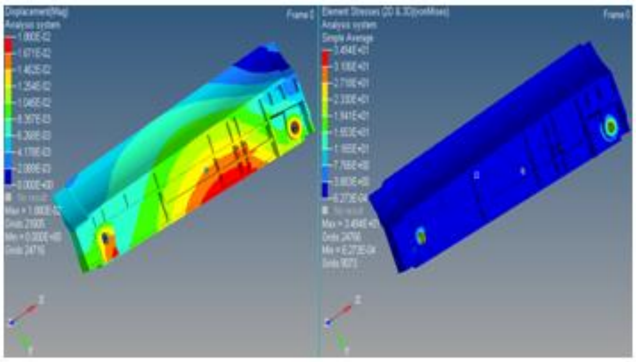


Fig.6.4 Dynamic Analysis

6.2 Energy Curves

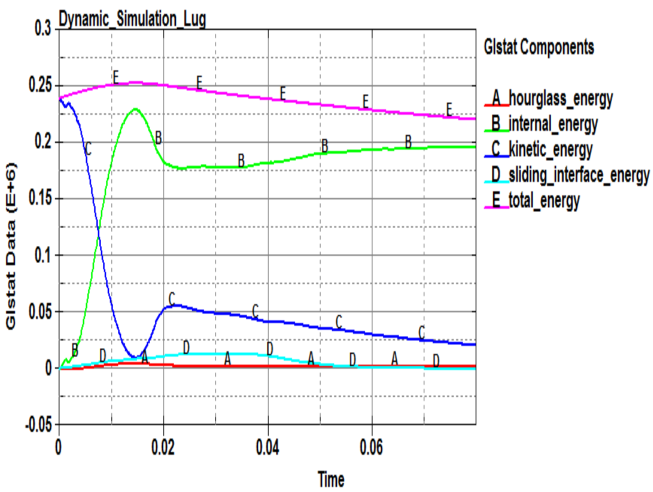


Chart -1: AL 8090 T851 Energy Curves

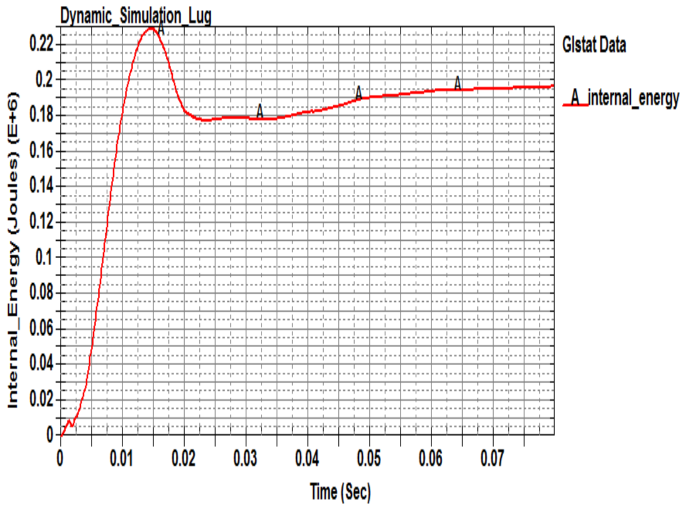


Chart -2: AL 8090 T851 Material Energy Curves

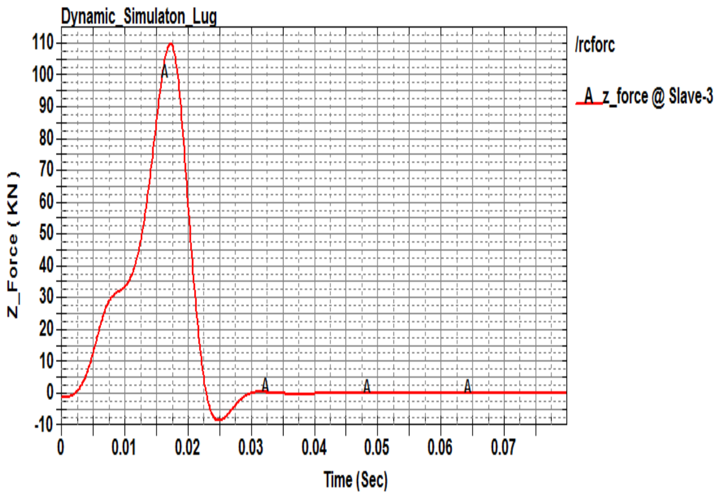


Chart -3: AL 8090 T851 Force Induced Curve

7. SUMMARY OF RESULTS & DISCUSSION

Table -7.1: Summary of Contour Plots

Simulation Load Case	Materials	Free Frequency	Constrain Frequency	Contour Plots		Weight
				Displacement	Stress	
Static Simulation	Al 8090 T851	1204 Hz	477.3 Hz	4.34 mm	8.07 Mpa	46 Kg
Dynamic Simulation		1204 Hz	477.3 Hz	18.8 mm	34.34 Mpa	46 Kg

From above table we can say that, in static simulation displacement is 4.34 mm with Stress value 8.07 and in Dynamic simulation, displacement is 18.8 mm with Stress value of 34.34 Mpa.

8. WEIGHT OPTIMIZATION

Weight optimization is done to reduce the weight of the material without affecting its strength. Here weight optimization of baseline model is done using SOLID THINKING software.

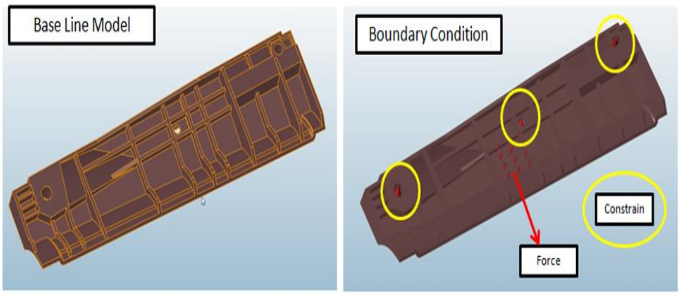


Fig.8.1 Baseline model and boundary conditions.

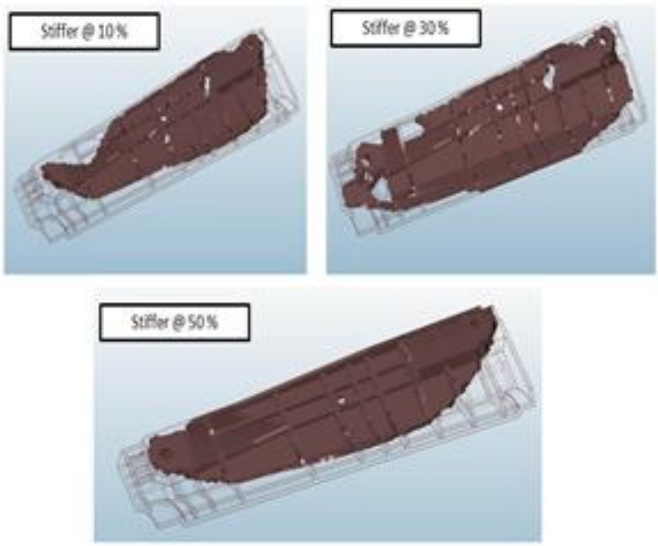


Fig.8.2 Optimized Models of Baseline Design

Final optimized model can be obtained as shown in figure 8.3.

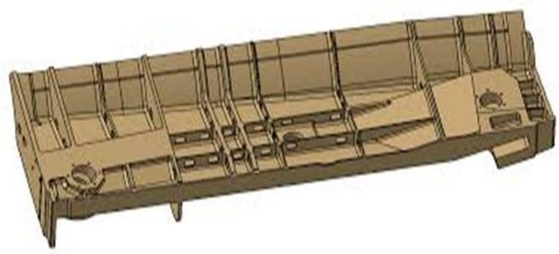


Fig.8.3 Final optimized model

8.1 Simulations of optimized model

Simulations are carried out for optimized model and contour plots are as shown below.

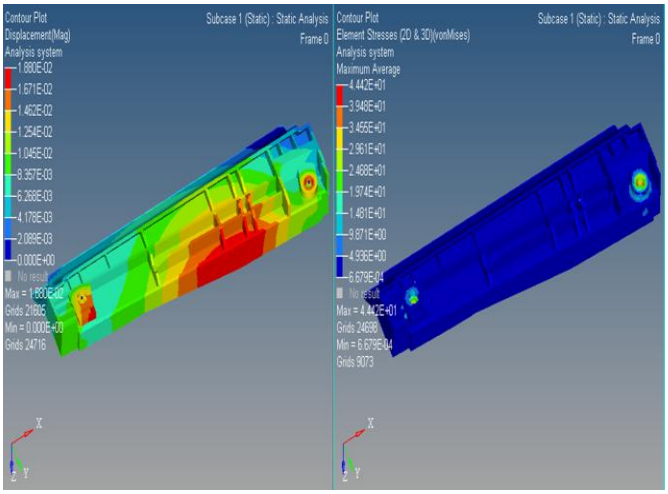


Fig.8.4 Vonmises stresses and displacement plots

Table 8.1 shows summery of the results of both baseline model and optimized model.

Table 8.1: Summary of contour plots

Design Model	Mass (Kg)	Material	Displacement (mm)	Vonmises Stress (Mpa)
Baseline Model	46	Al 8090 T851	18.8	34.34
Optimized Model	35.52	Al 8090 T851	18.80	44.42

9. CONCLUSION

Lug attachment Component of a nose landing gear withstands both static and dynamic loads these loads are calculated with the help of software like Hypermesh, Radioss and LS Dyna.

Since in aviation industries reduction of weight of plays a important role, weight of the lug attachment component is reduced by 10 Kg with the help of solid thinking software. Over all stress analysis of component and weight optimization of the component is done.

REFERENCES

1. Prasad Kabade, Ravi Lingannavar, "Design and Analysis of Landing Gear Lug attachment in an Airframe", International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 2, Issue 10, October 2013.
2. M. Pavankumara, Dr. Chitriki Thotappa, "Study of Supply Chain Flow of Integral Fuel Floor Component of LCA and Improving Its Machining Process (A case study at Hindustan Aeronautics Limited (HAL), Bangalore)", International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 4, Issue 3, May 2015.
3. Kuldip Ganorkar, Prof. Vishal Deshbhrata, "DESIGN OPTIMIZATION OF LANDING GEAR OF AN AIRCRAFT- A REVIEW" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X
4. Avinash V. Gaikwad, Rajesh U. Sambhe and Pravin S. Ghawade, "Modeling and Analysis of Aircraft Landing Gear, Experimental Approach", International Journal of Science and Research (IJSR), India Online ISSN: 2319-7064.
5. Kiran Shahapurkar, Ravindra Babu G, "Stress Analysis of an Aircraft Wing with a Landing Gear Opening Cutout of the Bottom Skin", International Journal of Engineering Research and General Science Volume 2, Issue 5, August-September, 2014
6. B.K. Sriranga, Dr.C.N. Chandrappa, R. Kumar and Dr.P.K. Dash, "Stress Analysis of Wing-Fuselage Lug Attachment Bracket of a Transport Aircraft", International Conference on Challenges and Opportunities in Mechanical Engineering, Industrial Engineering and Management Studies 2012.
7. Marcin Kurdelski, Andrzej Leski Air Force Institute of Technology, Warsaw, Poland "Crack growth analysis of the landing gear pull rod of the fighter jet aircraft", Publisher: Institute of Aviation Scientific Publications, Review of Aeronautical Fatigue Investigations in Poland during the period may 2009 to march 2011, 2011