CURRICULUM VITAE

NAME : **Dr. Dipak Kumar Maiti**

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Wife – Mrs. Aparna Maiti
Son – Master Swapnil Maiti

EDUCATIONAL QUALIFICATIONS:

Examination Passed	Year of Passing	University/ Institution	Class/ Rank	% of Marks/ CGPA
Secondary	1985	W.B.B.S.E.	I	77.44
Higher Secondary	1987	W.B.C.H.S.E.	I	73.50
B.E.(Civil)	1991	Calcutta	I	78.64
M.Tech.	1993	I.I.T. Kharagpur	I	8.68/10
Ph.D.(Aero-Structure)	1997	I.I.T. Kharagpur	-	-

PROFESSIONAL & RESEARCH EXPERIENCES:

1. **Since April 2014:** Professor at the Department of Aerospace Engineering, Indian Institute of Technology, Kharagpur; Taught UG and PG courses like Composite Structures, Aerospace Structural Dynamics, Finite Element Methods, Structures,

Advanced Structural Dynamics, Vibration Instrumentation and Control, Engineering Drawing and Graphics, etc.; Guided B. Tech and M. Tech Projects and Doctoral Research. Summary of activities at IIT, Kharagpur as per Annexure – I

2. **April 2007-April 2014:** Associate Professor at the Department of Aerospace Engineering, Indian Institute of Technology, Kharagpur; Taught UG and PG courses like Composite Structures, Special Topics in Structures, Aerospace Structural Dynamics, Engineering Mechanics, Engineering Drawing and Graphics, etc.; Guided B. Tech and M. Tech Projects and Doctoral Research. Summary of activities at IIT, Kharagpur as per Annexure – I

3. **October 2004 – March 2007:** Assistant Professor at the Department of Aerospace Engineering, Indian Institute of Technology, Kharagpur; Taught UG and PG courses like Composite Structures, Special Topics in Structures, Aerospace Structural Dynamics, Engineering Mechanics, Engineering Drawing and Graphics, etc.; Guided B. Tech and M. Tech Projects and Doctoral Research. Summary of activities at IIT, Kharagpur as per Annexure – I

4. **July 2002 – September 2004**: Scientist/Engineer 'D' at Aeronautical Development Agency, Bangalore was involved in Design and Analysis work of Light Combat Aircraft in the area of Structural Dynamics and Aeroelasticity. Summary of activities at ADA, Bangalore as per Annexure – II

5. **May 1998 – June 2002:** Scientist/Engineer 'C' at Aeronautical Development Agency, Bangalore was involved in Design and Analysis work of Light Combat Aircraft in the area of Structural Dynamics and Aeroelasticity. Summary of activities at ADA, Bangalore as per Annexure – II

6. **December 1996 – May 1998:** Senior Project Engineer at Department of Aerospace Engineering, Indian Institute of Technology, Bombay carried out Research and Development Activities in the Area of Aeroservoelastic Stability Analysis for LCA. Summary of activities at IIT, Bombay as per Annexure – III

7. **August 1994 – December 1996:** Junior Project Officer at Department of Aerospace Engineering, Indian Institute of Technology, Kharagpur carried out Research and Development Activities in the Area of Thermoelastic Analysis of Heated Launch Vehicle Structures. Summary of activities at IIT, Kharagpur as per Annexure – IV.

8. **July 1991 – July 1996:** M.Tech and PhD research work on impact response analysis of laminated composite structures. Summary of activities at IIT, Kharagpur as per Annexure – V.

9. Summary of Scholarships, Awards as per Annexure – VI
10. Publications & Presentations as per Annexure – VII
11. Principal Investigator/Co-PI of Sponsored Research/Infrastructural Projects/Consultancy Projects at IIT, Kharagpur:

SL No.	Title of Project	PI	Co-PI/PIs	Sponsor Agency	Cost (Rs. in Lakh)	Period
1.	Centre of Excellence for Composite Structures Technology Phase II	Dr. D. K. Maiti	Prof. M. K. Laha Dr. A. Ghosh	AR&DB New Delhi	75.90	Sept’04 to March’09
2.	Aeroelastic Tailoring of a Composite Lifting Surface Using Smart Structures Concept	Dr. D. K. Maiti	-	SRIC IIT-KGP	3.00	April’06 To March’09
3.	Design and Development of MR-Fluid Based Damper for Aircraft Applications	Dr. D. K. Maiti	Dr. A. Ghosh	ADA Bangalore	17.25	Sept’05 To December’07
4.	Aeroelastic Analysis of a Lifting Surface Employing Active Fiber Composite	Dr. D. K. Maiti	-	AR&DB New Delhi	8.96	August’05 To March’09
5.	FIST Program, Department of Aerospace Engineering (FAE)	H.O.D	Dr. D. K. Maiti Dr. A. Ghosh	DST NEW Delhi	105.00	April’06 To March’11
6.	Damage Assessment of Aircraft Structures From Limited Vibration Data (LVD)	Dr. D. Maity, Civil Engg.	Dr. D. K. Maiti	AR&DB New Delhi	8.452	April’10 To March’13
7.	Vibration Testing (VTAE)	Dr. D. K. Maiti	Dr. B. N. Singh	AIMIL Ltd., Kolkata	0.16545	10-07-2011 To 10-07-2011
8.	Damage Assessment of Composite Structures Using Swarm Based Optimization Techniques from Changes of Vibrational response (COR)	Dr. D. K. Maiti	Dr. D. Maity, Civil Engg.	ISRO, IIT Kharagpur Cell	27.563	01-04-2014 To 31-03-2017

12. Membership of Professional Societies

(i) Life Fellow (F-1172308), Institution of Engineers, India.

(ii) Life Member, Aeronautical Society of India.

13. Doctoral Research Theses Guided at IIT, Kharagpur:

S. No	Name of The Student	**Supervisor / Supervisors**	**Month & Year**	**Title of the Thesis**
1.	Chinmoy Kumar Kundu	Dr. D. K. Maiti & Prof. P. K. Sinha	July 2006	Nonlinear Finite Element Analysis of Laminated Composite and Smart Shells
2.	Sateesh Bandaru	Dr. D. K. Maiti	July 2009	Vibration Control of Aircraft Nose Landing Gear with Torsional Magneto Rheological Fluid Based Damper
3.	Prasanta Kumar Mahato	Dr. D. K. Maiti	March 2010	Static, Dynamic And Flutter Control of Laminated Composite Plates in Hygrothermal Environment Employing Active Fiber Composite
4.	Aditi Majumdar	Dr. D. K. Maiti & Dr. D. Maity	April 2013	Damage Assessment of Structures Based On Vibration Data Using Ant Colony Optimization
5.	Bharadwaj Nanda	Dr. D. Maity & Dr. D. K. Maiti	April 2014	Vibration Based Damage Assessment of Frame Structures Using Unified Particle Swarm Optimization
6.	S. C. Mohan	Dr. D. K. Maiti & Dr. D. Maity	March 2015	Frequency Response Function Based Structural damage Assessment using particle swarm Optimization: Numerical and Experimental Studies
7.	Neeraj Grover	Dr. D. K. Maiti & Dr. B. N. Singh	December 2014	Non-Polynomial Shear Deformation Theories for Structural and Aeroelastic Responses of Laminated Composite and Sandwich Plates with Material uncertainties
8.	Kulkarni Kamlesh Vasudeo	Dr. B. N. Singh & Dr. D. K. Maiti	Under Progress	Non-linear response Analysis of Laminated Composite Structures using RMVT with material uncertainty
9.	Sreehari V. M.	Dr. D. K. Maiti	Under Progress	Linear and Non-linear Buckling Analysis of Laminated Composite Structures with higher shear

				deformation Theories
10.	Jebieshia T. R.	Dr. D. K. Maiti & Dr. D. Maity	Under Progress	Damage Assessment of Laminated Composite Structures
11.	Praveen Shakya	Dr. M. R. Sunny & D. K. Maiti	Under Progress	Aeroelastic Analysis of Smart Wind Turbine Blades and Their Structural Health Monitoring
12.	Swarup Kumar Barman	Dr. D. K. Maiti & Dr. D. Maity	Under Progress	Assessment of Various Soft Computing Tools for Structural Health Monitoring
13.	Babu Ranjan Thakur	Prof. B. N. Singh & Prof. D. K. Maiti	Under Progress	Analysis of Smart Structures and Its Application in Aerospace Engineering
14.	Payel Chaudhury	Prof. D. Maity & Prof. D. K. Maiti	Under Progress	Analysis of Smart Structures and Its Application in Aerospace Engineering
15.	Pratik Tiwari	Prof. D. K. Maiti & Prof. D. Maity	Under Progress	Modeling of Various Damages and its effect on response of composite structures
16.	Prasant Kumar Swain	Prof. D. K. Maiti & Prof. B. N. Singh	Under Progress	Aeroelastic Analysis of Damaged Laminated Composite Structures

14. Conferences/Workshops Organized at IIT, Kharagpur:

i. Third International Conference on Theoretical, Applied, Computational and Experimental Mechanics (ICTACEM 2004), IIT Kharagpur, December 28-30, 2004.
ii. Fourth International Conference on Theoretical, Applied, Computational and Experimental Mechanics (ICTACEM 2007), IIT Kharagpur, December 27-29, 2007.
iii. International Conference on Vibration Problems (ICoVP), 19-22 January, 2009, IIT Kharagpur - 721 302, India
iv. Third National Conference on MEMS, Smart Structures and Materials (MEMS ISSS 2009), CGCRI Kolkata, October 14-16, 2009.
v. Fifth International Conference on Theoretical, Applied, Computational and Experimental Mechanics (ICTACEM 2010), IIT Kharagpur, December 27-29, 2010.
vi. Sixth International Conference on Theoretical, Applied, Computational and Experimental Mechanics (ICTACEM 2014), IIT Kharagpur, December 29-31, 2014.

15. Additional Information:

i. Member of National Team for Aero-elastic studies on Gas Turbine Rotor Blades, GTRE, Bangalore
ii. DSC member for PhD students of Aerospace Engineering Department of IIT-Kharagpur.
iii. DSC member for PhD students of Metallurgical & Material Engineering Department of IIT-Kharagpur.

iv. DSC member for PhD students of Civil Engineering Department of IIT-Kharagpur.
v. DSC member for PhD students of Reliability Engineering Centre of IIT-Kharagpur.

(Dipak Kumar Maiti)

ANNEXURE – I

Present Research & Development Activities

1. Design and development of MR fluid damper

The landing gear is one of the basic aircraft systems, which has a significant effect on aircraft performance and economy. The tasks of aircraft landing gears are of complex nature and lead to a number of requirements. The landing of an aircraft has to perform its "name-giving" task of absorbing the aircraft's vertical energy via the shock absorber and the horizontal energy by means of the brakes. At taxiing, the landing gear has to carry the aircraft over taxiways and runways of varying quality. Landing gear vibration includes self-induced oscillations referred to as shimmy and brake-induced vibration. Shimmy can be defined as a self-exited instability during take-off, landing or taxiing, involving up to three degrees of freedom. A severe occurrence of shimmy can damage the landing gear and its attaching structure, resulting in significant repair costs and airplane down time.

The present research aimed at the modelling and design of an MR-fluid damper primarily consisting of a cylinder and a piston rod. The copper wires are wound around the piston to generate magnetic field. The damper model is developed based on Bingham plastic shear flow models. The geometric parameters are varied to get the best possible parameters based on the available design space in the Nose landing gear of LCA.

2. Aeroelastic Analysis of Smart Lifting Surface

Modern civil and military aircraft wings are very often designed to carry external stores. Therefore, external stores have gained special importance in the consideration of wing aeroelasticity. In the case of transport aircraft, these are mostly underwing carried stores, such as large and heavy engines and fuel tanks. Whereas, fighter aircraft are required to carry numerous combinations of wing-mounted external stores, such as wide variety of missile configurations, bombs and fuel tanks. Very often, the stores exhibit dramatic changes in mass and inertia properties during one single mission due to the launch of missiles.

The use of smart-structure technology to control the structural dynamic instability and response of air vehicles attracted research and development efforts in recent years. Smart structural components such as piezoelectric patches are embedded/surface bonded in the structure and subjected to electric inputs that cause the structure to change its static and dynamic characteristics due to development of internal loads. The induced internal loads deform the surrounding structure and participate in its aeroelastic behaviour. Active fiber composites consist of a laminated structure and PZT-fiber plies. The PZT-fiber plies have continuous, aligned, PZT fibers in an epoxy layer, and polyimid/copper electrode films. The electrode films are etched into an inter-digitated pattern that effects electric field along the fiber direction, thus activating the primary d_{33} piezoelectric effect. The PZT fiber can be either fabricated individually, or cut from PZT plates.

3. FE analysis of Smart Multidirectional Composites

Piezoelectric materials produce mechanical strain when subjected to an electric field or alternately, generate an electric charge when subjected to a mechanical strain. This property gives piezoelectric materials the ability to act as actuators or sensors. The use of piezoelectric actuators and sensors to control undesirable response in structures has received a lot of attention in the recent years.

The exiting monolithic piezoelectric materials being used in smart structures pose several draw backs i.e., (i) low control authority due to their low stress/strain constants, (ii) brittle natures of piezoelectric crystals and (iii) relatively higher density compared to conventional aerospace structural materials, etc. The piezoelectric fibers are currently available and they may be used to manufacture synthetic piezo-fiber reinforced composites to overcome the above short falls.

In the present research study, it is aimed to utilize the active fibers in a lamina of composite structure to serve as sensors or actuators. These active fibers can be laid in one plane or multidirectional plane to achieve higher sensing and actuating capabilities. A finite element modeling technique including super element concept is developed to assess the performance of multidirectional composite structures with active fiber lamina composites to serve as sensors or actuators under hygrothermal environment.

4. Non-linear Analysis of Smart Composite Shells

Piezoelectric laminated composite shell structures are currently being used extensively in aircraft, space vehicles, ships, electronics appliances and other automotive structures as it satisfies structural performance requirements. Due to the coupling between the membrane and flexure terms, the composite shells can carry higher loads. When piezoelectric lamina is integrated into the composite laminated shells the adaptive capabilities of the shells are enhanced. However, shells undergo large bending deformations, resulting post bucking due to transverse mechanical loadings. Similarly, the piezoelectric laminated shells may undergo snap through resulting post buckling behaviour due to the complex electromechanical responses. The sudden changes from one equilibrium state to another, producing large shape changes, is important from a design point of view. So it is necessary to study and analyze the nonlinear load deflection curves of piezoelectric laminated shells under electromechanical loading conditions.

A geometrically nonlinear finite element analysis using nine-noded isoparametric elements is carried out to study the post buckling behaviour of piezocomposite shell panels subjected to transverse load. The shell geometry used in the present formulation is derived using an orthogonal curvilinear coordinate system. The mathematical formulation is based on the virtual work equations for a continuum with a total Lagrangian approach, and the material behavior is assumed to be linear and elastic. The nonlinear equations are solved by the arc-length method, in which both loads and displacements are controlled, to handle snap through behaviour. The piezoelectric bending moments induced by actuators and the bending moments induced by substrate lead to the active snap through buckling. The nonlinear responses of specially piezolaminated spherical, cylindrical and conoidal shells under mechanical and electrical loading, are analyzed and discussed.

5. Static And Dynamic Analysis Of Isogrid Structures

The basic functions of aerospace structures are to transmit and sustain the applied loads, provide a basic shape and to protect the payload .The search for lightweight and highly efficient structural components is a continuous process. Reducing the structural weight and improving the load carrying capabilities of these structures will allow designers to add additional capabilities while reducing cost. Shell stiffened structures have been used for many years to fulfill these applications. Most of the airframe components are normally plate or shell type structures. The usual means of stiffening is to use longitudinal stringers and frames or ribs. An alternate approach to stiffening is the concept of isogrid, which employs a repetitive equilateral triangular pattern of ribs. Isogrid structures show great promise for satisfying increased reliability and reduced cost requirements due to their adaptability to automated manufacturing. They also lend themselves to use in operational environments, due to their high strength, resistance to moisture absorption, and damage tolerance.

Application of the concepts of substructuring has been under utilized in FEM analysis. However in certain special cases like in the case of isogrids these concepts can be of much help in saving computational time and resources. The static analysis of the isogrids using the method of substructuring produces accurate results with the advantage that the order of computational of the analysis was much reduced. However a substructuring analysis would require more intermediate steps than the extensive FEM analysis. Compared to the computational time saved this extra intermediate steps can be undergone. In the dynamic analysis of the modal frequencies the results obtained through substructuring are also quite in agreement with the ANSYS results. Thus the property of one hexagonal element is utilized to assess the properties of the complete isogrids. Moreover eigenvalue determination which requires much computational time was made easy by decreasing the order of the eigenvalue equations.

6. Reliability Analysis of Composite Wing Subjected to Gust Loads

The design of any engineering system is a process of decision making, under constraints of uncertainty. The main sources of uncertainties in structural analysis and design are uncertainties in the determination of the physical and mathematical model used for analysis, including uncertainties in the failure criteria, uncertainties in the determination of the magnitudes, locations, frequency content and correlations of the external loads (either static or dynamic) and uncertainties in various structural parameters such as geometries, dimensions, material properties, and allowable (stochastic structure). These three categories do not include other more subjective uncertainties such as human errors in the design and production.

Aerospace structures are excited by aerodynamic loads, which are usually random in nature. Flow around the wing structure creates pressure fluctuations, which have a wide range of frequency and amplitude content. The same phenomena are caused by acoustic noise created by rocket and jet outlet flows. Rotating elements such as engines and rotors create excitations with a better defined frequency content that are in many cases random in amplitudes.

A reliability analysis was conducted for a composite wing subjected to continuous random gust. For this, gust load was represented by wing root bending moment and its probability distribution function was obtained. Monte Carlo simulation was used to handle random variables and numerical results show that failure probability increases nonlinearly with the growth of RMS gust velocity. As high aspect ratio and flexible wing is used, the effect of gust loads on the aircraft structures becomes more significant. The presented methodology can be efficient way to check the safety and reliability of aircraft structure subjected to gust. Also, based on the current project, the structural optimization for reducing gust loads and the active control technology for gust alleviation are also can be taken as challenging areas for further research.

7. Structural Health Monitoring

The damage detection technologies and to evaluate their residual life of structure are very important to assure the structural integrity of operating plants and structures. Damage may be caused under service conditions due to limited fatigue strength. They may also be due to mechanical defects during manufacturing processes. Sometimes the extent and location of damage can be determined through visual inspection. But visual inspection technique has a limited capacity to detect damage, especially when damage lies inside the structure and is not visible from outside. So an effective and reliable damage assessment methodology will be a valuable tool in timely determination of damage and deterioration state of structural member.

Modal parameters based analysis has several advantages over alternative techniques due to the fact that the modal parameters depend only on the mechanical characteristics of the structure and not on the excitation applied. Frequencies can be measured more easily than mode shapes and as a result they are less affected by experimental errors. In damage detection problem two objectives have to be attained; the location of damage and its magnitude or severity. From the changes in natural frequencies the inverse problem related to damage detection may be obtained to determine the location and percentage of damage.

ANNEXURE – II

Design & Development work at ADA

I joined the aeroelasticity group of ADA in May 1998 and spent first few months getting acquainted with the people and activities in the group. Since I worked in dynamics of composite structures during my M.Tech and Ph.D. period and aero-servo-elasticity for a research project, I used this time to pick up how to use the FEA softwares, ELFINI & MSC/NASTRAN for dynamics and aeroelasticity. The works done subsequently are given below:

1. Structural Dynamic & Aeroelastic Analysis of LCA

- ***Gust Response analysis***

The response of an airplane in flight due to gust is one of the most important dynamic response problems from the structural design considerations. Gusts are the result of atmospheric turbulence. The gust response analysis of clamped **LCA wing** structure based on the modal information was carried out for a continuous turbulent gust using **MSC/NASTRAN**. This study was required from the certification point of view.

- ***Dynamics & Flutter analysis of LCA TD1 with patched wing with R73E missile***

The LCA weaponry report states that the aircraft production version (PV2) and beyond would carry the R73E missiles at the outboard pylon station. The wing when analysed with the R73E missile, showed the tendency to flutter within the flight envelope. A detailed analysis was carried out and design modifications in the form of a patch on upper and lower skins from midboard pylon station to wing tip were suggested to ensure flutter free behaviour of the aircraft.

- ***Dynamics & Flutter analysis of LCA TD1 with R73E missile***

It may be required to fly **LCA TD1** (with unmodified wing) with the **R73E missile** at the outboard pylon station later in the programme for weapon integration study. A study was made to identify the flutter free envelope for TD1 with R73E missile.

- ***Dynamic analysis of LCA PV1 & PV2***

The individual mass of each structural and non-structural parts of rear fuselage of LCA PV1 was distributed to simulate the inertia properly. There was lot of model corrections to eliminate local modes. The dynamic and flutter analyses of LCA PV1 was carried out and a technical report was prepared for internal circulation. The analysis for PV2 model is in advance stage.

- ***Load estimation of flight flutter test***

The structural loads expected during subsonic flutter testing of LCA TD1 were computed analytically and the corresponding fatigue damage to the airframe was estimated. It is seen that the damage caused by the proposed levels of excitation is negligible, and that the structure is safe from the stress point of view.

- ***Static & Dynamic analysis of Rake***

It was proposed that exhaustive measurement of the engine inlet flow characteristics be carried out on the LCA-TD2 through a set of rakes mounted at the inlet region of the engine. As a part of qualification test requirements to be met before installation of **the rake assembly at the inlet region of the engine**, the dynamic characteristics of the rake need to be evaluated. In this regard, the rake assembly was analysed for both static and dynamic loading conditions.

- ***Aeroelastic Analysis of Equivalent LCA***

The equivalent LCA model was translated to MSC/NASTRAN and its modal characteristics were compared with those of ELFINI. Aeroelastic analysis of the equivalent LCA was subsequently carried out.

- ***NASTRAN Verification: Flutter analysis***

The **LCA wing** structural model was translated from ELFINI to NASTRAN. The modal mass, modal stiffness and the modal vectors as obtained from ELFINI were replaced in the appropriate modal module of NASTRAN. Based on the modal information, the flutter analysis was carried out in NASTRAN and results were compared with those of ELFINI

- ***Aeroelastic optimisation***

Aerospace vehicles are complex engineering systems whose performance depends on the interaction of various mechanical and aerodynamic phenomena. A Multidisciplinary Design Optimisation (MDO) is required to achieve an optimum design based on certain performance criteria and constraints. MDO was carried out for an Aircraft wing structure with vibration and aeroelastic constraints.

- ***Data Transfer for ASE analysis***

The modal information data of LCA dynamic analysis were extracted from ELFINI for subsequent **ASE** analysis.

2. Shimmy Analysis of LCA nose landing gear

- ***MATLAB based code developed for shimmy analysis***

During the first block of flight of LCA TD1, a typical vibration problem was observed for nose landing gear, called as shimmy. A landing gear is said to shimmy when it undergoes both lateral and torsional oscillations during take-off, landing or taxiing. A MATLAB based code was developed to predict the **shimmy vibration** characteristics of NLG. After a thorough comparison with the open literature, the shimmy model was tuned for **LCA-NLG** and results were generated for various combinations of system parameters.

- ***Building LCA NLG model in ADAMS software***

To simulate detailed model of **LCA-NLG,** a general-purpose software, ADAMS developed and marketed by Mechanical Dynamics Inc., USA, was procured by HAL, Bangalore. It has the capability to model landing gear and simulate shimmy vibration instability. The LCA-NLG was modeled in ADAMS/Aircraft module with the help of MDI. The detailed shimmy analysis was carried out at Ann Arbor, USA with the help of their experts.

- ***Development of Simplified FEM model of LCA nose landing gear***

FE models of torque links of LCA TD1 were developed to calculate the effective torsional stiffness of NLG in MSC/NASTRAN. A simplified model of NLG of TD1 was also developed to study the static and dynamic characteristics of LCA-NLG.

3. Vibration Analysis of LCA LRUs

- ***Stores Interface Box***

The **stores interface box for LCA** is designed by NPOL, Kochi. The dynamic characteristics of the stores interface Box was studied and the necessary modifications were suggested.

- ***Pylon Interface Box***

The **pylon interface box (PIB) for LCA** is designed by BEL, Bangalore. The modal characteristics of the pylon interface Box was studied and necessary modifications were suggested. The modified PIB was subjected to static g-load and random vibration. The analysis showed that PIB could withstand the vibration.

- ***Engine Control & Fuel Management controller***

During qualification test of ECFMC, there was failure of lock mechanism. After close observation of the failed box the necessary modifications were suggested. During sine weep test one of the screws failed. The analysis was carried out and necessary suggestions were given to the concerned group.

- ***Data Recording Unit***

The data-recording unit was modeled for FE analysis and necessary qualification tests were simulated. The analysis showed that it is safe from stress point of view.

- ***Solid State Crash Data Recorder***

The solid state crash data recorder was modeled for FE analysis and necessary qualification tests were simulated. The analysis showed that it is safe from stress point of view.

- ***Cockpit Interface Unit***

The cockpit interface unit was modeled for FE analysis and necessary qualification tests were simulated. The analysis showed that it is safe from stress and vibration level point of view.

4. Smart Structural Activities

- ***Smart Structural Analysis***

2-D coupled field **piezoelectric elements** were developed along with structural element to sense structural response and actuate with the application of voltage. It has the capability to generate piezo-actuator forces in NASTRAN format. The force can be applied as an actuator force through controller to suppress undesirable response. **One M-Tech student** was **Guided** to develop frontal solver based smart structural analysis code and helped another **M-Tech student** to carry out the smart structural analysis using ANSYS. The thesis title was **"Finite Element Analysis of Structures with surface bonded piezoelectric actuators and/or sensors"**

- ***Development of Response Analysis Module in MATLAB***

MATLAB based software was developed to calculate **transient and frequency response analysis** based on the modal model of a system for smart structural analysis.

- ***Design of MR-fluid damper***

Active vibration control of structures using Magnetorheological (MR) and ER fluids has attracted considerable interest among structural design engineers. These fluids are used in damper systems along with active feedbackcontrols. In this work, the design and characterization had been carried out of a MR fluid damper for vibration suppression in nose landing gear assembly. One **M-Tech student was guided** for his thesis work in this field. The thesis title was "**Design Of A MR Fluid Damper For Active Vibration Control".**

5. Other Research & Development Activities

- ***Validation of STAAC***

Aerodynamic Pressure distribution, pressure coefficients, aerodynamic efficiency and divergence dynamic pressure were calculated for some simplified wing configurations using **NASTRAN** to compare with those of **STAAC and ELFINI**.

- ***Validation of SWIBOSC***

The Subsonic Wing Body Oscillatory Code is an aerodynamic code with body aerodynamics developed by Dept. of Aerospace Engg., IIT-Kharagpur. The code was used to generate aerodynamic loads on the equivalent LCA wing and simple plate configurations, in an attempt to validate the code. The code was ported to RISC 6000. Discussions were held with Prof. Laha (IIT-Kharagpur), who developed this code, with regard to the new version of the code. He also clarified several issues pertaining to the work of the code.

- ***Aeroelastic Analysis of SARAS aircraft***

The aeroelasticity group of NAL was helped to carry out Aeroelastic analysis of **SARAS aircraft** using MSC/NASTRAN.

ANNEXURE – III

'Aeroservoelastic Stability and Response Studies for LCA (ADA)'

The aim of the sponsored project by ADA, Bangalore was to study the stability criteria and response characteristics of fighter class of aircraft with automated flight control systems. Aeroelastic instabilities such as wing divergence (static) and flutter (dynamic) of an aircraft could lead to catastrophic failures. The present day fighter aircraft design incorporates extensive use of automatic flight control systems for stability and control of the aircraft and there is a potential threat to structure control interaction leading to aeroservoelastic instabilities within the normal flight regime. Therefore, it is essential to indentify the unstable flight zones and study the dynamic response of the aircraft within the flight regime. Three technical reports were prepared.

ANNEXURE – IV

'Thermostructural Analysis of Heated Launch Vehicle Structures'

A sponsored research project was awarded from VSSC, Thiruvananthapuram to develop a computer code for obtaining temperature distribution over a body exposed to thermal environment such as heat flux or aerodynamic heating and the structural response under this environment. The computer code was developed with all the heat transfer modes such as conduction, convection and radiation for thermal analysis. The structural and thermal analyses were supported by 2 and 3 noded beam and bar elements, 8 and 9 noded rectangular isoparametric elements, 18 and 20 noded isoparametric volume elements, 8 noded axisymmetric element and 9 noded shallow shell element. Four technical reports were prepared.

ANNEXURE – V

M. Tech and Doctoral Research

The research was primarily aimed at investigating the dynamic response of laminated composite structures due to impact of a spherical mass with initial velocity. The analysis for the dynamic behaviour of target structures were carried out using the finite element method employing higher-order shear deformation theories. The response analysis had been done using the Newmark's time integration scheme. The effects of different boundary conditions, stacking sequences and fibre orientations on the impact response of laminated composite structures were studied. Based on the research work, seven technical papers had been published in four International Journals and one was in National Journal. Four papers had been presented in different conferences in India.

ANNEXURE – VI

SUMMARY OF SCHOLARSHIPS AWARDED

1. National Scholarship Holder during 1985-1991.
2. MHRD Scholarship for M.Tech. Programme during 1991-1993.
3. MHRD Scholarship for PhD Research Programme during 1993-1994.

ANNEXURE – VII

LIST OF PUBLISHED WORK

Technical Papers:

International Journals:

1. ‘An inverse trigonometric shear deformation theory for supersonic flutter characteristics of multilayered composite plates’, Neeraj Grover, B. N. Singh, and D. K. Maiti, Aerospace Science and Technology, 2015 (Accepted)
2. ‘Bending and buckling analysis of smart composite plates with and without internal flaw using an inverse hyperbolic shear deformation theory’, Sreehari V. M. and D. K. Maiti, Composite Structures, 2015 (Accepted).
3. ‘Damage assessment of Composite Structures using Partcle Swarm Optimization’, Jebieshia T. R., D. K. Maiti and D. Maity, International Journal of Aerospace System Engineering, 2(2), 24-28, 2015.
4. ‘Buckling and post Buckling Analysis of Composite Plates with Internal Flaws’, Sreehari V. M. and D. K. Maiti, International Journal of Aerospace System Engineering, 2(2), 19-23, 2015.
5. ‘Analytical solution for bending and buckling analysis of functionally graded plates using inverse trigonometric shear deformation theory’, Kamlesh Kulkarni, B. N. Singh and D. K. Maiti, Composite Structures, 2015 (Accepted).
6. ‘Buckling and Post buckling Analysis of Laminated Composite Plates in Hygrothermal Environment Using an Inverse Hyperbolic Shear Deformation Theory’, Sreehari V. M. and D. K. Maiti, Composite Structures, 129, 250-255, 2015.
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