

Session I:

TRACK 1 - Product Definition & Visualization

INVITED TALK 1:

Sizing Of An Aircraft Configuration - Case Studies

Mr. P Jaisimha,

HAL(ARDC), Bangalore, India

PLMSS06016:

Rendering Point-based Representations of Engineering Models

Sushil Bhakar, Ramgopal Rajagopalan, S. P. Mudur

PLMSS06084:

Catmull-Clark Subdivision and Skinning of Incompatible Curves

Dr. Kailash Jha

PLMSS06062:

Post-Processing Performance Enhancement of the Finite Element Software FINESSE/FINEGRAF

J. Rajasankar, G.S Palani, Nagesh R. Iyer and T.V.S.R. Appa Rao

Rendering Point-based Representations of Engineering Models

Sushil Bhakar, Ramgopal Rajagopalan, S. P. Mudur

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Abstract: With the advent of high resolution fast 3D scanners, obtaining accurate geometric data of 3D objects has been made relatively easier. The raw geometric data is available in the form of points sampled over the surface of the object. NURBS has been the most popular surface fitted over this sampled point set. A relatively new approach for 3D scanned object representation that is gaining increasing popularity is the direct use of point as the universal geometric primitive. This has the advantage that the process of surface fitting is not needed and the representation is simple; there is no connectivity information to be coded. Surface splatting and its variants are standard techniques for rendering point sampled surface models to ensure a continuous image of the surface. While this technique produces acceptable results for sculptured surfaces, it cannot directly handle engineering shapes which usually have sharp features like holes, protrusions, edges and corners. We present a method to overcome these drawbacks of surface splatting for point models. Features like edges and corners are detected using eigenvalue analysis on local neighborhood of point data. This allows us to handle rendering of engineering shapes more accurately. For visibility computations, a flat node represented by an opaque polygon is used to maintain the correct Z-buffer values, thus overcoming the need to splat every point in that node in both passes. To further speed up, we implement the above techniques using programmable graphics hardware. We believe that such improved rendering methods are needed if point based graphics has to find wider application in engineering design.

Catmull-Clark Subdivision and Skinning of Incompatible Curves

Dr. Kailash Jha

Faculty-in-Charge, CAD/CAM Center, Indian School of Mines, Dhanbad, India

Abstract: In current work an algorithm for subdivision of surfaces and solids by Catmull-Clark subdivision have been developed and skinning of incompatible curves have been discussed. In the proposed work the incompatible curves have been converted into compatible curves and finally skinned surfaces are obtained by Catmull-Clark subdivision. The Catmull-Clark subdivision is a powerful tool to skin not only the incompatible curves but also the intersecting network of curves. The algorithm of knot insertion to get the compatible curves may result in an astonishing number of control points if the compatibility of the input sectional curves is not enough, this has been overcome in present formulation. Even approximation technique to obtain compatible curves may have problems due to improper parameterization. The present formulation can also overcome the branching problems in skinning of surfaces. In this work subdivision of polyhedrons has been obtained for several parts.

Post-Processing Performance Enhancement of the Finite Element Software FINESSE/FINEGRAF

J. Rajasankar^{*}, G.S Palani^{*}, Nagesh R. Iyer^{*} and T.V.S.R. Appa Rao^{\$}

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Abstract: This paper describes a set of additional post-processing features developed specifically into an existing version of the finite element software FINESSE/FINEGRAF by SERC. The features are integrated with FINESSE/FINEGRAF in order to enhance its performance. The control and numerical processing requirements are handled through suitable functions written in 'C' language while the demand on graphical user interface is managed by making use of X-Windows, Motif and GPACK graphics libraries. In order to realize this, new data structures have been inserted into the software apart from modifying some of the existing ones. Explanation about the additional features, which are meant to enhance the performance of the software, is also included in the paper

Session I:

TRACK 2 - Product Modeling & Analysis

INVITED TALK:

Life Cycle Engineering & Sustainability of Composite Materials

Dr Talreja, Texas A&M University, USA

PLMSS06030:

Stochastic Finite Element Reliability Analysis of Plates/Shells under Dynamic Excitations with Adaptive Mesh Refinements

M. Manjuprasad, C. S. Manohar

PLMSS06034:

Gear Stress Analysis and Study of Transmission Error

J. S. Rao, S. Suresh, M. Jayakumar, G. Devaradjane

PLMSS06042:

A New Approach to Response Surfaces for Reliability Analysis

Rajib Chowdhury, B. N. Rao and A. Meher Prasad

Stochastic Finite Element Reliability Analysis of Plates/Shells under Dynamic Excitations with Adaptive Mesh Refinements

M. Manjuprasad

Structures Division, National Aerospace Laboratories, Bangalore, India, 560017

C. S. Manohar

Department of Civil Engineering, Indian Institute of Science, Bangalore, India, 560012

Abstract: A technique for stochastic finite element reliability analysis of plates/shells under dynamic excitations with adaptive random field mesh refinements is proposed in this paper. Layered quadratic (nine noded, Heterosis) degenerated shell elements are used for finite element modelling. Spatially varying stochastic system parameters (such as Young's modulus) are modeled as non-Gaussian random fields with prescribed marginal distribution and autocorrelation function in conjunction with Nataf's models. Expansion optimum linear estimation method is used for random field discretisation. Structural reliability analysis is carried out using first order reliability method. Newmark's direct integration technique is used for solving the equations of motion. The performance function is defined in terms of peak displacement at a given node in the given time duration. Sensitivity measures in terms of gradients of the performance function with appropriate transformations are proposed and used as refinement indicators for carrying out adaptive random field mesh refinements. Reliability index based error indicator is proposed and used for assessing the percentage error in the estimation of notional failure probability. Adaptive mesh refinement is carried out using hierarchically graded mesh obtained through bisection of elements. The performance of the adaptive stochastic finite element reliability analysis approach developed is illustrated by solving the problem of a laminated rectangular plate subjected to jet force.

Gear Stress Analysis and Study of Transmission Error

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G. Devaradjane

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Abstract: Most commonly adopted Gearing design procedure is based on AGMA standards to evaluate bending and contact stresses. This work investigates characteristics of an involute gear system using finite element methods. Bending and contact stresses are evaluated using nonlinear FE methods and then compared against AGMA standards to establish an accurate design procedure. Transmission error and torsional gear mesh stiffness are also determined

A New Approach to Response Surfaces for Reliability Analysis

***Rajib Chowdhury, B. N. Rao and A. Meher Prasad**

Structural Engineering Division, Department of Civil Engineering, Indian Institute of Technology Madras
Chennai 600036

Abstract: Approximation methods are widely used to accelerate the computational efficiency of engineering analyses. For structural reliability analyses, the common approach is to use the response surface method based on the least square regression. Moving least square (MLS) approximation has gained popularity especially in the field of mesh free analysis. However, the application of the MLS to structural reliability problems has not been realized until recently. Therefore, this paper investigates the use of the MLS method for structural reliability problems by comparing it with the conventional reliability analysis tools. A new weight function is introduced, in order to locate the important region(s) on performance function. It helps to identify the existence of multiple design points and/or regions on the limit surface which have significant contributions to the failure probability. In addition to the effort of identifying the region of importance, the method requires a small number of exact or numerical evaluations of the performance function at selected input. Results of numerical examples indicate that the proposed method provides sufficiently accurate and computationally efficient estimates of probability of failure.

Session I:

TRACK 3 - Product Realization

INVITED TALK:

Conceptual Design, Analysis & Fabrication Of A Micro-Cooling System For Thermal Management Of Electronic Equipment

Prof P Nithiyarasu,
Univ. of Swansea, UK

PLMSS06052:

Overview of Micromachining Processes
Kamlakar P Rajurkar, Murali M Sundaram

PLMSS06050:

Mathematical Model to Study Thermal Stresses induced in Electro-Discharge Machining
Deepak Kumar Panda, Rajat Kumar Bhoi

PLMSS06055:

Process Optimizations via Physics Based Modeling and Simulations for Composite Material Product Developments
Ram Mohan and Ajit Kelkar

Overview of Micromachining Processes

***Kamlakar P Rajurkar, Murali M Sundaram**

Center for Nontraditional Manufacturing Research, University of Nebraska – Lincoln,
Lincoln, Nebraska, USA

Abstract: The rapidly increasing demand for miniaturized components from diverse industries such as aerospace, biomedical, automobile, healthcare and consumer electronics has necessitated the need for innovative micromachining processes. Micromachining over the years has matured to become an indispensable technology that offers reliable solutions to produce complex shaped micro parts made of metals, ceramics, polymers and composites. This paper presents an overview of the micromachining processes and techniques being practiced worldwide. A general classification of micromachining processes is provided. Capabilities of individual micromachining processes have been discussed. A comparison of the major micromachining processes and emerging trends in this field have been reported. Recent research results of micro-Electrical Discharge machining (micro-EDM), micro-Electrochemical Machining (Micro-ECM) and micro—Ultra Sonic Machining (micro-USM) projects (funded by the U.S. National Science Foundation) are presented. Related issues such as education and environmental aspects are also been briefly discussed.

Mathematical Model to Study Thermal Stresses induced in Electro-Discharge Machining

***Deepak Kumar Panda**

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Rajat Kumar Bhoi

Department of Mechanical Engineering, University College Of Engineering, Burla, India

Abstract: Extremely steep temperature gradients induce thermal stresses, which can cause a network of micro-cracks, damaging the electro-discharge machined surface. In this context, study of the behavior of thermal stress propagation under a single spark has drawn attention of researchers in developing mathematical, numerical and empirical thermal stress models. Review of these models reveals few limitations in terms of too many assumptions and too simplified boundary conditions. Considering the limitations of the earlier models, the close form solution of three-dimensional heat conduction transient is used as forcing function to obtain the mathematical expression of thermal stresses. The temperature distribution function is obtained considering electro-discharged machine surface, which is both axially and radially infinite subject to uniform heat flux of a spark. A parametric study has been undertaken to characterize the thermal stress distribution. The study reveals that the induced thermal stresses exceed the ultimate stress of the material beyond the crater, which is the most crack prone.

Process Optimizations via Physics Based Modeling and Simulations for Composite Material Product Developments

***Ram Mohan and Ajit Kelkar**

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Greensboro, NC 27410, USA

Abstract: Manufacturing processes with limited experience for composite material product development can benefit greatly from physics based process modeling and simulations during the process maturation and product development life cycle. Optimization approaches can further automate the application of these physics based process modeling and simulations. The optimization of injector port locations is an important, but time consuming process by trial and error based methods for liquid composite molding processes, even with high fidelity physics based computational modeling and simulations. Two optimization techniques applicable for the optimization of location of injection ports in processing of the composite material product is presented. The limitations of the gradient based continuous sensitivity equation (CSE) approach and the population search methods such as genetic algorithms (GA) are discussed. A coupled GA-CSE optimization framework in the context of optimizing the injector locations for the resin transfer molding process enabled with physics based process flow modeling and simulations is presented. The robustness of the coupled approach to automatically find the physically correct, optimal locations is demonstrated via an illustrative example.

Session II:

TRACK 1 - PLM Framework

INVITED TALK :

Evolving PLM From An Operational Support Tool To A Strategic Tool In An On Going Program

Dr RK Ramanathan,

Project Director, Technology Development, ADA, Bangalore, India

PLMSS06056:

Airbus Aerodynamic Framework : AeroCity

T.Chevalier, B.Marquez, P.Sauvage

PLMSS06087:

Next Generation Knowledge Based Engineering Applications for Digital Vehicle Programs

Mr. Abhay Tarnekar, Mr. Yogesh Deo, Mr. Avijit Santra

PLMSS06006:

Influencing factors and prepositions for PLM systems implementation in Indian Industry

J.Suresh

Airbus Aerodynamic Framework : AeroCity

T.Chevalier, B.Marquez, P.Sauvage

Airbus France

Abstract: Increasing capabilities of computational fluid dynamics lead to industrial explosion of numerical simulation usage, for quantitative prediction of aircraft performance and not only for qualitative or tendency estimation. Aerodynamic numerical simulation is however more & more relying on high performance computing and networking, with processes that are still young and changing, both characteristics defeating usage of usual engineering frameworks and product data management systems. A dedicated solution was therefore glued together from existing commercial building blocks, to harness and master these new capabilities and deliver efficient industrial capability for Airbus aerodynamic domain. Specifically high benefits can be observed in term of ease of integrating new tools or applications, as well as knowledge capture and trace-ability of the work performed.

Next Generation Knowledge Based Engineering Applications for Digital Vehicle Programs

Mr. Abhay Tarnekar, Mr. Yogesh Deo, Mr. Avijit Santra

KBE & Engineering Systems, Tata Technologies Ltd, Pune – 411018

Abstract:The demand for quality products in the quickest possible time-to-market in automotive industries has been on a rising trend world-wide and similar trends are also observed in India recently. Increased competition has forced most automakers to think in better planning and implementation of design and manufacturing processes, allowing them to drastically reduce cycle time for a new product introduction. The global competition, rising steel and oil prices along with numerous excise duties imposed by the government are the threats along with growing concern about retaining human resources and their knowledge within the industry. Though industry is prudently deploying various tools and processes like PLM (CAD/CAM/PDM), CAE, Manufacturing Planning, and ERP, it however lacks the crucial component “management of knowledge”.

Knowledge Based Engineering (KBE) bridges the gap between Design Automation and Knowledge capture & reuse. Tata Technologies has developed its own propriety software framework in line with Next Generation Knowledge Based Engineering technology.

With this technology, it provides real results over the traditional design approach of manufacturers and engineering organizations are having today. Till date, there exist numerous standalone programs written in FORTRAN, C, C++, Visual Basic and Excel spreadsheets. While these automation solutions satisfy specific product development needs, they are often not part of a system solution nor are they tightly integrated into the mainstream of PLM. Many of such automated solutions present serious shortcomings (like maintenance, rules update etc) compared to the next generation KBE technology.

Influencing factors and prepositions for PLM systems implementation in Indian Industry

J.Suresh,

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Abstract: Product Development is the most important function for firms that compete in dynamic markets. Product Lifecycle Management (PLM) has become increasingly important for effective management of product development activities in these firms. PLM is a concept rather than a system. The main objective of this paper is to identify the factors that influence PLM systems implementation in the Indian context. Influencing factors effects on PLM systems implementation are identified for industries like Aerospace, Automobile, Defense, Heavy Engineering and High Tech. Our findings are interesting and useful to industry. Each industry needs are different and unique. Hence, presently available PLM systems in the market demand more customization for achieving more benefits from them in different industries.

Session II:

TRACK 2 - Product Optimisation & Design

INVITED TALK :

Shape Optimisation To Improve Life Cycle Of Bladed Disks In Turbo Machinery

Dr J S Rao

Consultant, Altair Engineering, Bangalore, India

PLMSS06092:

Machine- Bed Weight Optimization by GENSIZ

B.V.Vijay

PLMSS06023:

Evolving Path Generation Compliant Mechanisms (PGCM) using Local-search based Multi-Objective Genetic Algorithm

Deepak Sharma*, Kalyanmoy Deb and N. N. Kishore

PLMSS06002:

Genetic Algorithm Based Optimization Of Fuzzy Based Attitude Controller For A Spin Stabilized Micro-Satellite

Suman Reddy .K , S.Lakshmi, J.Shanmugam

Machine- Bed Weight Optimization by GENSIZ

B.V.Vijay

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Abstract: CNC- machines are typically built by integrating many high- precision subsystems onto a cast- iron bed. Because of the need to maintain accuracy under the high speeds of operation, such bed's designs are primarily driven by their modal characteristics. In particular, one would desire that the bed's modal frequencies are as high as possible in order to minimize frequency- dependent contribution to the inaccuracy. While increased wall thicknesses would generally yield increased modal frequencies, for weight- efficient design, such thickness distribution would have to be an optimum. Recently such an optimization study was done for a typical bed produced by a leading CNC- machine manufacturer in India. The versatile genetic search method was adopted, as it is known to yield relatively more robust designs. The tool was an in- house size- optimization code, GENSIZ, interfaced to the industry- standard FE solver, MSC/ NASTRAN. The FE solver ensures that modal characteristics would be reliably estimated as well. The objective was to maximize the design's performance- to- weight ratio, performance being measured by a Euclidean- norm of the lowest few natural frequencies. Results show that nearly 30% weight saving could be achieved on the existing design, sacrificing performance just by about 4%. Also, a large number of near- optimum designs resulted that could serve as design- alternatives. We conclude that an 'integrated' GA- FE tool such as GENSIZ could yield designs that are both robust and reliable in character.

Evolving Path Generation Compliant Mechanisms (PGCM) using Local-search based Multi-Objective Genetic Algorithm

Deepak Sharma*, Kalyanmoy Deb and N. N. Kishore

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Abstract: Path generation compliant mechanisms (PGCM) are flexible structures which generate some desired path and/or transmit force by undergoing elastic deformation (under some applied load) instead of through rigid linkages/joints as in rigid body mechanism.

In the present work, multi-objective problem is posed for evolving of PGCM using local-search based genetic algorithm. Minimization of weight of structure and minimization of input energy to the structure have been considered as two conflicting objective functions subjected to maximum of 10% of deviation between five precision points of prescribed path and corresponding five points obtained on the actual path of a specified point on structure after FEM analysis and a constraint on stress. Geometrical non-linear finite element model is used for the synthesis of PGCM. On the basis of the calculated function and constraint values, an evolutionary algorithm (NSGA-II) is used to find the optimal solution.

A local search based multi-objective GA is used to reduce the computational time and improve the quality of GA solutions. The Pareto-optimal front obtained shows trade-off solutions from minimum weight to the maximum weight of structure. The minimum weight solution is corresponding to the maximum input energy to the structure and vice-versa.

Genetic Algorithm Based Optimization Of Fuzzy Based Attitude Controller For A Spin Stabilized Micro-Satellite

SUMAN REDDY .K , S.LAKSHMI, J.SHANMUGAM

Department of Electronics Engg, MIT-Anna University, Chennai, INDIA

Abstract: This paper presents genetic algorithm based optimization of fuzzy logic controller for various modes of attitude controller for a spin stabilized micro satellite in low earth orbit. The various modes of attitude control include detumbling with initial spin-up, spin rate control-up and spin rate control-down using only magnetic actuator. A magnetic moment produced by coils placed on the satellite will produce a resultant torque by interaction with the geomagnetic field, which may be used for attitude control purposes.

In this work, controllers that are used consist of Multi Input Multi Output (MIMO) fuzzy logic controller. Also Single Input Single Output fuzzy logic controllers are used to control the spin rate. The fuzzy logic controller parameters are optimized to attain an objective function or performance index. The settling time for the above mentioned modes of attitude control are taken as the objective function. The main objective of the paper is to optimize the value of membership function widths in off-line over a large search space using genetic algorithm, to attain the performance index with the help of given number of fuzzy rules. The optimized results are compared with the existing fuzzy controller on the basis of performance indices.

Session II:

TRACK 3 - Product Realization

INVITED TALK:

Micro Channel Heat Sinks In The Thermal Management Of Electronics Systems

Prof KN Seetharamu

Jain College of Engineering

PLMSS06090:

A Knowledge Based System for Process Selection: A front-end to Web-based Manufacturing

B. V. Mehta, V. Shankar, J. S. Gunasekera, D. Sormaz

PLMSS06085:

Densification in Selective Laser Sintering and Effect on Stress-Life in the Downstream of Product Lifecycle

Regalla Srinivasa Prakash, Amit Kumar Singh, Prakash Sethumadhavan, Pradeep Ghute

PLMSS06089:

RoboNET: A Web Based Robotic Assembly Planning System

Vivek Anand, V. B. Sunil, S. S. Pande

A Knowledge Based System for Process Selection: A front-end to Web-based Manufacturing

B. V. Mehta, V. Shankar, J. S. Gunasekera

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D. Sormaz

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Abstract: A rule-based expert system was developed to assist the researcher in selecting a manufacturing process for a given product or product feature. The decision made by the expert system is presented to the user through a web browser and sent back to the client machine for the virtual workshop component of the web-based manufacturing environment to load the virtual machines. Next the sequence of manufacturing process can then be determined by the user for a given product. Based on the sequence of manufacturing processes selected for a certain product, the appropriate machines will be loaded in a virtual workshop created using VRML. The details of the expert system and the integration to the web-based manufacturing environment will be discussed and presented.

Densification in Selective Laser Sintering and Effect on Stress-Life in the Downstream of Product Lifecycle

#Regalla Srinivasa Prakash, Amit Kumar Singh, Prakash Sethumadhavan, Pradeep Ghute

Birla Institute of Technology and Science, Pilani – 333 031 (Rajasthan).

Abstract: Thermal and densification simulation of selective laser sintering (SLS) of amorphous Bisphenol-A polycarbonate using the finite element method was carried out. The aim of the simulation was to study the influence of the simulation parameters on the temperature and density variations which have a profound effect on the stress-life in the down-stream of the product lifecycle. Two different sintering models, model-1 and model-2 were employed. The details of this modelling simulation and improvements and refinements of results obtained by the use of model-2 over that using model-1 are presented. Features of simulation enabling better modelling and understanding of the effect of process parameters on the quality of the sintered product are pointed out.

RoboNET: A Web Based Robotic Assembly Planning System

Vivek Anand, V. B. Sunil, S. S. Pande*

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Indian Institute of Technology Bombay, Powai, Mumbai – 400076

Abstract: This paper reports the design and implementation of RoboNET, a Web Based Robotic Assembly planning system for Online (Virtual) and Offline (Vision Based) programming of robotic work cell. Developed in a Thin client-Thick server web architecture, it enables geographically distributed clients to do the real time robotic assembly planning and execution from anywhere, anytime. Both Joint and robot level programming can be done using Virtual Teach Pendant while task level programming can be done using Vision Based Interface in the RoboNET. Algorithms have been developed to process the robotic workspace image to extract information on assembly world space. Robot program is automatically generated for the specified tasks considering the grasp and motion planning of the robot. The user can send the robot program (through web) to the robot to carry out the assembly task in a Tele mode. The assembly operation can be viewed by the user through web camera installed at the robot site.

Session III:

TRACK 1 - Product Definition & Visualization

INVITED TALK :

Advancing Problem Definition and Concept Generation for Improved PLM

Easwaran Subramanian, CMU & NIST, USA

PLMSS06037:

Virtual Product Development: a strategic axis at Airbus

Pierre BACHELIER

PLMSS06082:

Understanding the knowledge needs of the designer during design process in industry

Gokula Vijaykumar A.V¹ and Amaresh Chakrabarti²

PLMSS06005:

CollabCAD : A Collaborative Workbench for Integrated Manufacture

Dr. Savita Dawar, Mr. C.J. Antony

Virtual Product Development: a strategic axis at Airbus

Pierre BACHELIER

Head of Modelling Simulation, AIRBUS S.A.S.

Abstract: Modeling and Simulation are key enablers to improve the design and the development process of aircraft. They are intensively used at Airbus in most of the disciplines: aerodynamics, loads, performance, acoustics structure analysis, system design,.. al along the development cycle. A specific project called **Common Virtual Bird** has been set up to address the key challenges towards the Virtual Product based development concept. Collaborative system engineering must be **Architect driven**.

Understanding the knowledge needs of the designer during design process in industry

Gokula Vijaykumar A.V¹ and Amaresh Chakrabarti²

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Abstract: In this competitive scenario of product development, product success is substantially influenced by satisfaction of the knowledge needs of designers. In literature many tools and methods are proposed to support satisfaction of these needs. But, adoption of these methods in industrial set-ups is minimal. This may be due to an inadequate understanding of the knowledge needs of designers in an industrial set-up. This research attempts to bridge this gap by undertaking a descriptive study in an industry. In this paper we propose a preliminary taxonomy of knowledge on the basis of analyzing the questions asked by the designers during interactions. Since the list of taxonomy will only lead to a partial understanding of the needs we converted the questions asked into a generic form with the help of the taxonomy. These generic questions are aimed to provide an understanding about the following: (i) what knowledge must be captured during the design process? (ii) What should be the structure of this knowledge? We believe that this preliminary taxonomy and generic questions should aid in a better understanding of the knowledge needs of the designers.

CollabCAD : A Collaborative Workbench for Integrated Manufacture

Dr. Savita Dawar, Mr. C.J. Antony

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Abstract: CollabCAD is a distributed CAD/CAM software system, which provides a total solution from product definition and visualization to CAE and CFD. It is an initiative of the CollabCAD Consortium comprising of NIC along with strategic organizations such as BARC, VSSC, NPCIL, IGCAR, ADA, GTRE, NAL and SERC. CollabCAD is developed using open source software tools and supports open standards for interoperability. Besides the conventional CAD/CAM features, it also provides a collaborative framework. To integrate CAD with PLM, CollabCAD provides an interface to a content repository and workflow system and incorporates security, locking, and versioning of the engineering drawings. CollabCAD also provides an interface to an enterprise automation software.

Session III:

TRACK 2 - Product- Optimisation & Design

INVITED TALK

Hierarchical Procedures for the Analysis of Security, Feasibility & Uncertainty in Distributed Design of Engineering Systems

Dr Ganesh Subbarayan
Purdue University, USA

PLMSS06031:

Interoperability and structuring issues in the knowledge based engineering driven structural design of an aircraft component

J.Dhayandhi, S.Manju, Satish Chandra, Sun Xia Sheng, Duan Shihui

PLMSS06041:

SMA structures computations

M. L. Boubakar and Ch. LExcellent

PLMSS06064:

Design and Development of Shape Memory Alloy Based Non-explosive Release Mechanism

Kushal Singh, Ashish Tewari, Amol R. Shet

Interoperability and structuring issues in the knowledge based engineering driven structural design of an aircraft component

J.Dhayandhi, S.Manju, Satish Chandra

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Sun Xia Sheng, Duan Shihui

Aircraft Strength Research Institute (ASRI), Xian, China

Abstract: This paper describes knowledge based engineering studies on a typical aircraft structural component (a lifting surface design) at the preliminary design level as well as at the hi-fidelity FEA stage. A number of important issues were examined, including the status of KBE, its previous emphasis on rules and tacit knowledge, while the present approach especially in a PLM/PDM environment is largely data driven. We found that while preliminary models (PMs) are phenomenological in nature, there could also be regarded as being object oriented in a very natural way. Also based on the work, we examine the interoperability issues, especially AP209 in its application to CAD and FEA as well as interoperability issues between preliminary design models and CAE models and even with the operation of a feature level data base, considerable issues are required to be resolved such that preliminary design data could be seamlessly converted to CAD and CAE models. With the use of databases, browsers and objects and the realization that preliminary models are actually structured that conforms to well accepted aircraft design approaches, a hierarchical structure can be created for preliminary design. Experience from the development of a tool in PCL (Patran Command Language) is also described based on work conducted at ASRI. The tool provides opportunities for carrying out layout changes, changes to the layout based on an aerodynamic profile using rib contours.

SMA structures computations

M. L. Boubakar and Ch. LExcellent

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FRANCE

Abstract: Within the framework of the normal dissipative processes theory, a plasticity-like model is proposed for the shape memory alloys pseudoelastic behaviour. Its numerical implementation is performed using return mapping algorithms. Originally designed for elastoplasticity, this kind of algorithms requires suitable modifications in order to assure the uniqueness of the computed solution. A constitutive frame for proportional and non-proportional loading is also proposed for finite strains analysis.

Design and Development of Shape Memory Alloy Based Non-explosive Release Mechanism

Kushal Singh, Ashish Tewari

Directorate of Engineering, Defense Research and Development Organization

Amol R. Shet

Directorate of Instrumentation, Defense Research and Development Organization

Abstract: The paper presents the design and development of a Shape Memory Alloy based Non-Explosive Release Mechanism (SNERM). In this, Release Mechanism the general scheme is to take advantage of the ability of SMA to recover a parent shape when heated by an electrical current. Thus, an SMA actuator may be used to trigger a mechanism that releases a captive element.

The main advantage that such kind of non explosive release mechanisms offer over traditional pyro-activated release mechanisms is that of Noiseless operation and avoidance of end-of-deployment ^[1] shock loadings thus eliminating the vibration disturbances which are detrimental to sensitive electronic equipments. Also, such mechanisms are reusable unlike their pyro counter parts.

Session III:

TRACK 3 - Product Realisation

INVITED TALK

PLMSS06067

Characterisation of Cylindrical Drug Delivery Devices Using Rapid Prototyping

S.H. Masood and Arvind Kumar Thunga

PLMSS06095

An investigation on the mechanism of friction-stir weld formation and tool design

K. Kumar and Satish V. Kailas*

PLMSS06038

Modeling and Simulation of an Idealized Nanoscale Motor

Kittisak Koombua, Ramana M. Pidaparti

Characterisation of Cylindrical Drug Delivery Devices Using Rapid Prototyping

S.H. Masood and Arvind Kumar Thunga

Faculty of Engineering & Industrial Sciences, Swinburne University of Technology,
Hawthorn, Melbourne, Australia 3122

Abstract: With the improvement in the technology, Rapid Prototyping techniques have begun to be applied in the field of biomedical devices in medicine. The controlled release of drugs is an important area in which rapid prototyping techniques can be successfully used in developing models of release matrix for drug delivery devices. This paper deals with the characterisation of cylindrical Drug Delivery Device (DDD) models with one such RP technique, the Fused Deposition Modeling (FDM). The main aim is to see if the matrix model fabricated using this technique is feasible to be used as a successful drug delivery device. Using various parameters involved with FDM, polymeric DDD matrices with different macrofeatures are fabricated. Experiments are conducted to study the release characteristics of the fabricated models with a model drug and to see how they are affected by FDM build parameters.

An investigation on the mechanism of friction-stir weld formation and tool design

K. Kumar and Satish V. Kailas

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Abstract: Understanding the mechanism of friction stir weld formation is important to optimize the tool design. In this investigation, experimental study has been conducted to analyze the mechanism of weld formation, and find out the basis for tool design. For this purpose the experiments are conducted with different shoulder and pin diameters, and their effect on material flow and weld formation is analyzed. The results reveal that for a particular pin diameter there is an optimum shoulder diameter; below which the weld is defective, and above which the symmetry of the weld is lost. In addition to that, based on the material flow characteristics the mechanism of friction stir weld formation is proposed. The experimental results and the proposed mechanism will be helpful in tool design and optimumizing welding parameters.

Modeling and Simulation of an Idealized Nanoscale Motor

Kittisak Koombua, *Ramana M. Pidaparti

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Abstract: A nanomotor was designed using geometries and dimensions from a nuclear pore complex. A flow within this bio-inspired nanomotor was analyzed using a finite element method. The analyses involved velocity and pressure distributions. The results demonstrated a possibility to use this nanomotor in a micro/nanosystem. A prototype of this nanomotor was created using a stereolithography rapid prototyping machine

Session IV:

TRACK 1 - PLM Framework

INVITED TALK

Visualization: Trends and Technologies

Mr. Praveen Bhaniramka

CEO Darshan IT Solutions, Delhi.

PLMSS06081

A Model for Life Cycle Cost Estimation for Defence Equipment

AM Nageswara Yogi

PLMSS06024

Efficient life cycle information modelling for new generation civil aircraft product structures

Satish Chandra, K.N. Ramakrishna, N. Nanda Kumar, Kota Harinarayana

PLMSS06053

Object Oriented Paradigm for Remaining Life Assessment of Structural Components

A. Rama Chandra Murthy, G.S. Palani, Nagesh R. Iyer

A Model For Life Cycle Cost Estimation For Defence Equipment

AM Nageswara Yogi

Aeronautical Development Establishment, Department of Defence Research Development Organization, Bangalore – 560 075

Abstract: The estimation of Life Cycle Cost (LCC) of any system assumes importance for decision-making during procurement, up-gradation of systems. LCC of a system in service if estimated periodically will help the user to decide to continue or scrap it. Several models available for LCC estimation address the effects of only a small number of cost drivers. These models have to be modified to provide meaningful answers to queries raised by users. In this paper, a generalized computer model developed using Cost Breakdown Structure (CBS) is presented. CBS helps us to consider a large number of parameters for LCC estimation. Sensitivity of LCC of a fighter aircraft for parameters like production quantity, total flying hours is tested. The outputs of the model help us to analyze various costs involved in the LCC of a system. Comparison of LCC of a number of similar systems can be obtained.

Efficient life cycle information modelling for new generation civil aircraft product structures

Satish Chandra, Structures Division, National Aerospace Laboratories, Bangalore

K.N. Ramakrishna, Formerly with Tech Services, Jet Airways Mumbai

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Kota Harinarayana, Raja Ramanna Fellow, National Aerospace Laboratories,
Bangalore

Abstract: Civil aircraft design and development under the Federal Aviation Regulations (USA) or the European Aviation Safety Agency (EASA) have rigorous life cycle management regulations based on approval obtained from a Maintenance Review Board (MRB) procedure. Many components, systems and airframe structures are subject to life limitations, inspections and overhaul at well-documented and specified intervals of the aircraft's life. It appears that product life cycle management (PLM) in the operator (airline) environment is in many situations, limited to inventory, labour and task management. However, a fully integrated PLM cycle should include feedback and information through a federated environment to manufacturers, third party suppliers, maintenance organisations and operators and to a limited extent, regulators as well. This paper describes the current practices in developing the maintenance planning of commercial aircraft, especially those certified under FAA and EASA regulations. The Maintenance Planning Documents (MPDs) are developed based on damage tolerance, safe life and fail safe evaluations using logic diagrams that describe functional failure scenarios as well. We carried out a detailed review of the MPDs of two commercial aircraft and discuss the integration of appropriate information into a PLM architecture. Present PLM architectures may be limited to that being used by the product developer, while in civil aircraft operations, operator feedback and ability to carry out repairs and use third party parts will be vital for cost management in an industry driven by wafer thin margins. New generation civil aircraft should incorporate a PLM architecture that would use product life cycle information to enable higher level of efficiencies in operation.

Object Oriented Paradigm for Remaining Life Assessment of Structural Components

A. Rama Chandra Murthy, G.S. Palani, Nagesh R. Iyer

Abstract: This paper discusses the application of object oriented programming (OOP) concepts for remaining life prediction of structural components. Brief introduction to OOP concepts and database have been explained. To meet one of the requirements of damage tolerant design of structural components, interactive and user-friendly software, has been developed by using OOP concepts. Remaining life has been predicted by using linear elastic fracture mechanics principles. This software has been developed on MS-Windows based platform with VC++ as the front end and MS-Access as backend. Application of OOP concepts with reference to this software has been explained. Database design for typical structural components with different crack configurations has been shown in the form of tables. The details of various program modules and structure of graphical user interface (GUI) have been outlined. The efficacy of the software has been demonstrated with one example problem through GUI.

Session IV:

TRACK 2 - Product Optimisation & Design

INVITED TALK

A New Multi Fidelity Approach to Robust Design of Aerospace Vehicle Considering Fidelity Uncertainty

Prof K Sudhakar
IIT, Mumbai, India

PLMSS06025

A Self-Adaptive Recombination-Cum-Mutation Strategy For Single and Multi-Objective Evolutionary Optimization

Karthik Sindhya, Kalyanmoy Deb, Tatsuya Okabe

PLMSS06088

Sensitivity study to improve the structural frequency by tailoring of Wing skin layup

Sudha.U. P. V, Mahadesh Kumar. A and Kamesh J.V

PLMSS06040

Multi-Objective Optimal Design of Composite Laminates Using a Tabu Enabled Ant Colony Optimisation Algorithm

A. Rama Mohan Rao, P. Srinivasan

A Self-Adaptive Recombination-Cum-Mutation Strategy For Single and Multi-Objective Evolutionary Optimization

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Kanpur, Kanpur, India

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Abstract: In this paper, we deal with a self-adaptive recombination operator which has been paid a little attention in the Evolutionary Algorithm (EA) literature, although the recombination operator is a unique feature of the EA search. Particularly, we consider the simulation binary crossover (SBX) [1] and polynomial mutation operator [4] used for real-parameter EAs, in both single and multi-objective genetic algorithms [2]. The SBX and mutation operators use a non-dimensional probability distribution which involves a distribution index parameter η_c (η_c) and η_m (η_m) respectively. In this paper, we assign a random index value to each solution in the initial population and then update them based on whether the crossover mutation operation was successful or not. Based on the famous $1/5^{\text{th}}$ success rule [3], we have devised a self-adaptive scheme for updating the η_c and η_m parameters.

We incorporate the self-adaptive schemes in single-objective real-parameter GAs as well as multi-objective Non-dominated Sorting Genetic Algorithms-II (NSGA-II) and apply them to a number of test problems. In all cases, better results are obtained compared to the corresponding GAs with a fixed value of the crossover and mutation parameters. The self-adaptive schemes are now ready to be applied to real-world problems and better solutions are expected than the standard evolutionary algorithms.

Sensitivity study to improve the structural frequency by tailoring of Wing skin layup

Sudha.U. P. V, Mahadesh Kumar. A and Kamesh J.V

Loads and Aeroelasticity Group, Airframe Directorate, Aeronautical Development Agency, Bangalore

Abstract: This paper reports a study wherein the directional properties of a composite wing skin have been altered locally to meet the required objective of decoupling the control and structural frequencies. However, it is found that, it is not possible to increase the structural frequencies beyond a certain frequency without going for a redesign of the parent structure. The sensitivity study has been followed up by a response analysis, to ensure that the modification has served its purpose.

Multi-Objective Optimal Design of Composite Laminates Using a Tabu Enabled Ant Colony Optimisation Algorithm

A. Rama Mohan Rao, P. Srinivasan

Structural Engineering Research Centre, CSIR Campus, Taramani, Chennai- 600113

Abstract: This paper explores ant colony optimization (ACO) algorithm for lay-up sequence optimisation of laminate composite panels. The ACO algorithms are multi-agent systems in which the behaviour of each ant is inspired by the foraging behaviour of real ants to solve optimization problems. The main objective of this paper is to demonstrate the effectiveness of the ACO algorithm for the combinatorial problem like stacking sequence optimisation of laminate composite panels.

Session IV:

TRACK 3 - Product Modeling & Analysis

INVITED TALK

Finite Elements – 50 years after

Dr. Swami Narayanaswami,

Chairman and Managing Director, CSM Software Pvt. Ltd., Bangalore, India

PLMSS06068

Investigation of Waviness of Wavy Fins and Maldistributions Effects on the Performance of Compact Plate Fin Heat Exchanger

Ch. Ranganayakulu, L. Sheik Ismail , S. Rajeshwar, M. Ramu, V. Vasudeva Rao

PLMSS06075

Simulation Of Life Cycle Enhancement Of A ‘Heat Sink’ Through The Control Of Casting Process Parameters –A Case Study

M.Venkataramana, V.Vasudevarao, R.Ramgopal Varma, J.Kalyana Veera Madhav

PLMSS06072

The Effect of Sub Size Specimen on Crack Growth of SENB Specimen

Vijay Kumar Sutrakar, D. S. Sreedhar

Investigation of Waviness of Wavy Fins and Maldistributions Effects on the Performance of Compact Plate Fin Heat Exchanger

Ch. Ranganayakulu & L. Sheik Ismail

Aeronautical Development Agency, Bangalore

S. Rajeshwar, M. Ramu and V. Vasudeva Rao

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Abstract: A typical Compact Plate-Fin Heat Exchanger has been analyzed using Computational Fluid Dynamics (CFD) simulation tool for quantification of flow mal-distribution effects and the effect of the waviness on the performance. In addition, a suitable baffle plate has been designed based on CFD study for improvement in performance. On the basis of experimental data, the existing empirical ‘j’ and ‘f’ data for core of Wavy fin Heat Exchanger is re-analyzed using CFD tool “Fluent”. The effect of waviness of Wavy fin surface has been analyzed using CFD tool. The prediction of ‘j’ and ‘f’ data using CFD tool covering the laminar, transition, and turbulent flow regimes are comparable with the experimental results and the open literature. It was found that the effect of flow mal-distribution is quite significant in these Heat Exchangers. Also, the waviness plays a major role in the performance of the heat exchanger.

Simulation Of Life Cycle Enhancement Of A ‘Heat Sink’ Through The Control Of Casting Process Parameters –A Case Study

M.Venkataramana^{*}, V.Vasudevarao⁺, R.Ramgopal Varma[^], J.Kalyana Veera Madhav[^]

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Abstract: The Role of Shrinkage porosity in the performance of any typical cast component will be vital in the enhancement of the service life of major equipment like motors, castings etc. Shrinkage porosity can be reduced by controlling the casting process parameters. Simulation studies of heat sink casting process are conducted using VIRTUAL CASTING simulation software and optimum process parameters are determined by TAGUCHI method. It is observed that insertion of chill is the decisive factor in obtaining “Heat Sink” casting with minimum possible porosity. Confirmation experimental trail is conducted at optimum condition and results are in phase with simulation studies. In the present work, an attempt is made to optimize the casting process parameters like pouring temperature, pouring time, gating ratio and insertion of chill for minimizing the shrinkage porosity of a heat sink casting of an automobile gear box made of A356Aluminum alloy to enhance the useful life of heat sink and the equipment to which it is attached to. Taguchi technique, a well-demonstrated statistical technique, is used to arrive at a systematic experimental plan for attaining the objective function of minimizing shrinkage porosity.

The Effect of Sub Size Specimen on Crack Growth of SENB Specimen

***Vijay Kumar Sutrar**

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D. S. Sreedhar

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Abstract: This paper presents the effect of thickness on sub size three-point bend specimen. In the investigation, the *Single Edge Notched Bending* (SENB) specimens have been used to evaluate fracture parameters experimentally for $a/W=0.5$. Various specimens are tested to find out the effect of thickness on crack growth. Load versus *Load line displacement* (LLD) and Load versus *Crack Mouth Opening Displacement* (CMOD) are plotted for the varying B/W ratio. J is measured for all specimens at various level of crack growth experimentally. Results of J - Δa and crack growth of standard SENB $a/W=0.5$ and $B/W=0.5$ i.e. 12 mm thick specimen (as per the ASTM Standard) had been compared with sub size specimen $B/W=0.25,0.125$ i.e. 6 mm and 3 mm thick specimens to find out the effect of thickness.

Session V:

TRACK 1 - PLM Framework

PLMSS06057

How In-Service Experience Informs Design Modifications: A Case Study in Aero Engines

***Santosh Jagtap, Aylmer Johnson, Marco Aurisicchio and Ken Wallace**

PLMSS06065

Qualitative Analysis of Configuration Spaces: An approach to abstracting function in Part Families

Madan Mohan Dabbeeru, Mukerjee

PLMSS06070

System-of-Systems Engineering in a Global Environment

Mr. Marion L. Butterfield, Dr. Jay Pearlman, Dr. Stephen C. Vickroy

PLMSS06045

Aerodynamic Design and Analysis with High Fidelity Analysis Tools

G. R. Shevare, Ashish Choudhari, Basant Kumar Gupta and Irshad Khan

How In-Service Experience Informs Design Modifications: A Case Study in Aero Engines

***Santosh Jagtap, Aylmer Johnson, Marco Aurisicchio and Ken Wallace**
Engineering Design Centre, Trumpington Street, Cambridge, United Kingdom

Abstract: This research is triggered by a fundamental shift that is occurring in the manufacture and marketing of aero engines for commercial and defence purposes, away from the selling of products to the provision of services. Under the emerging ‘power by the hour’ paradigm, aero engines are effectively leased to the airlines, with the manufacturing company remaining responsible for their maintenance and repair throughout their service life. This has triggered a major re-assessment of the design of aero engines to reduce their overall life-cycle costs, while maintaining performance efficiency. The important aims of our ongoing research are: firstly to understand the current flows of in-service information to designers; secondly to understand the information requirements of designers about in-service issues; thirdly to develop the most appropriate theories and methods to support designers in their new task. This paper presents the results of the initial phase of an ongoing research project, which is addressing the first aim of the research, and analyses a sample of service documents currently used by the manufacturing company. Within this sample, a distribution pattern of failure mechanisms across turbines, compressors and combustion chambers has been identified, and the prominent design changes to resolve those failure mechanisms and their benefits are noted. The relationships between some of the parameters are presented, e.g. the type of design changes made to address a particular failure mechanism, and the typical benefits of a particular design change.

Qualitative Analysis of Configuration Spaces : An approach to abstracting function in Part Families

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Amitabha Mukerjee

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Abstract: The mapping of structure to function remains one of the vexed problems in conceptual design, since function is contingent on possibility, and keeps evolving with the design. This shift however is less pronounced in part families, which are related in their functional behaviour, a similarity which is also reflected in their motion configuration spaces. We define two types of part families - based on a) functional similarity and b) geometric similarity, and show how qualitative analysis of the configuration space can reveal motion invariants that are related to function in both instances. We model conceptual shapes in terms of structural variations by decomposing 3D shapes into cognitively plausible volumetric primitives (geons), and show that a functional product family, represented by variational geons, result in qualitatively similar configuration spaces, and models for deriving performance remain invariant. Using a padlock family and with the configuration space as part of the product family platform, we show how such a conceptual design process for geometric part families may be implemented today in commercial CAD engines.

System-of-Systems Engineering in a Global Environment

Mr. Marion L. Butterfield

Integrated Defense Systems, The Boeing Company, Seal Beach, CA

Dr. Jay Pearlman

The Phantom Works, The Boeing Company, Seattle, WA

Dr. Stephen C. Vickroy

The Phantom Works, The Boeing Company, Houston, TX

Abstract : Boeing's role as one of the world's leading Lead-System-Integrators (LSI) of commercial and military system of systems (SoS) has resulted in the requirement to perform Systems of Systems Engineering in a global environment. To support this role Boeing has developed a new, innovative Systems Engineering approach that goes beyond the current industry Systems Engineering processes. The new Boeing System of Systems Engineering (SoSE) Process represents a significant breakthrough in the development of complex net-centric systems of systems and constituent systems.

The SoSE Process provides a complete, detailed, and systematic development approach for systems of systems. Boeing's new architecture-centric, model-based Systems Engineering process emphasizes concurrent development of the system architecture model and system specifications. It is applicable to all phases of a system's lifecycle. The SoSE Process is a unified approach for system architecture development that integrates the views of each of a program's participating engineering disciplines into a single system architecture model supporting civil and military domain applications.

Aerodynamic Design and Analysis with High Fidelity Analysis Tools

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Ashish Choudhari, Basant Kumar Gupta and Irshad Khan

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Abstract: On one hand, Computational Fluid Dynamics (CFD), an extremely versatile technology requiring high performance computing environment has poised to take over as universal software for simulating multi-physics problems in industrial R&D; on the other, it has not replaced wind tunnel as a preferred method analysing the aircraft configurations. The present paper analyses this anomaly and describes efforts undertaken to enhance the usage of the CFD technology for aircraft design. It details the software modules: ShapeZ™ (surface modeller), GridZ™ (Grid generator), FlowZ™ (Generic density based solver) and ViewZ™ (post-processor) and their integration into CFDExpert™ for high fidelity simulation and CFDManager™ for bulk simulations.

Session V:

TRACK 2 - Product Modeling & Analysis

PLMSS06063

Modeling of System Dynamics of Static Test Bed and Correlation with Experimental Results

G Yoganand, P Pakeeruraju, Subhasish Mohanty, Amol Ravikant Shet

PLMSS06066

Crack Arrest Model for a Piezoelectric Ceramic Strip Weakened by Two Collinear Straight Cracks

R.R Bhargava, Satish Kumar, Namita Saxena, Amit Setia

PLMSS06076

High Performance Computing and Structural Mechanics Activities at C-DAC

M. S. Shah & R.D.Chaudhari

PLMSS06046

A C^0 Finite Element for Free Vibration of Smart Laminated Composite Plates with Random Material Properties

B. N. Singh and Nikhil Vyas

Modeling of System Dynamics of Static Test Bed and Correlation with Experimental Results

G Yoganand, P Pakeeruraju, Subhasish Mohanty

Product Design and Engineering Division, Directorate of Engineering

Amol Ravikant Shet

Directorate of Instrumentation, Defense Research and Development Laboratory,
Kanchanbagh, Hyderabad

Abstract: Static firing tests of different rocket motors are conducted to evaluate various parameters like thrust, pressure, exit gas velocity etc. From experiments, it is found that the thrust profile obtained from load cell has lot of discrepancy compared to the expected thrust obtained from engine simulation. This difference in static firing results might be because of the effect of rocket motor holding arrangements and variation of system mass with time. Multi-body dynamics may be considered as an integration platform for simulation of system dynamics. In the present paper, we discuss lumped mass modeling of the above system for single degree of freedom using classical numerical technique. The system was also simulated for multi body dynamics with flexible holding arrangement. The simulation results are compared with the experimental results. This system modeling is useful for designing the compensator to compensate the discrepancy in thrust characteristics.

Crack Arrest Model for a Piezoelectric Ceramic Strip Weakened by Two Collinear Straight Cracks

R.R Bhargava¹, Satish Kumar², Namita Saxena³, Amit Setia⁴

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Abstract: A strip yield model is proposed for an infinite piezoelectric ceramic strip weakened by two collinear hairline straight cracks. The strip is of finite thickness and the edges of the strip are subjected to prescribed out-of plane displacement and in-plane potential drop both of them open the rims of the cracks. The ceramic strip under consideration is assumed to be mechanically brittle and electrically ductile, consequently a mechanical singularity is encountered first. Hence one encounters a slide zone developed ahead of each of the tip of the cracks. To arrest the cracks from further opening the rims of the developed zones are subjected to uniform anti-plane yield point shear stress. Fourier transform method is employed and the problem reduces to the solution of corresponding singular integral equations. These are then solved analytically. Expressions are obtained for mechanical and electrical displacements, stress intensity factors, energy release rate and crack sliding displacement at inner and outer tips of the crack.

High Performance Computing and Structural Mechanics Activities at C-DAC

M. S. Shah & R.D.Chaudhari

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Abstract: Using advanced computational resources; simulation and modeling of a vast array of engineering and mathematical problems have led to truly evolutionary insights into the phenomena of nature. Detailed structural analysis is necessary for cost-effective performance by way of improving fuel efficiency, reducing the structure weight, increasing the structure strength and making the structure pliable. These technologies are vital in major engineering areas such as space structures, onshore and offshore structures, specialized pressure vessel structures and so on. Detailed structural analysis involves discretization of real life configuration into a large number of elements, seeking solutions for problems with many unknowns by way of numerical techniques such as finite element methods (FEM). A set of linear or nonlinear algebraic equations is usually obtained in FEM, the solution of which gives the approximate behavior of the continuum or system. The number of equations is usually rather large for most real-world applications of the FEM, and requires the computational power of the digital computer. In this paper the research and developmental work carried out at C-DAC, in high performance computing in structural mechanics and its specialized applications is discussed. Many applications such as multi-scale material modeling, fatigue analysis etc. require supercomputing and grid computing resources. The high performance computing and grid computing trends are discussed here. The aerospace engineering applications demand huge computing resources and a possible answer to this is collaborative programmes among domain experts and HPC community.

A C^0 Finite Element for Free Vibration of Smart Laminated Composite Plates with Random Material Properties

B. N. Singh and Nikhil Vyas

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Abstract: In the present work, the free vibration study of piezoelectric laminated composite plate with random material properties has been attempted. Randomness in lamina material properties has been modeled as basic random variables. System equations have been derived using higher order shear deformation theory. A C^0 finite element method (FEM) in conjunction with first order Taylor series based perturbation technique has been employed to obtain mean and standard deviation of natural frequency of the system equations. Typical numerical results are presented for all edges simply supported boundary condition. The results have been compared with ones available in the literature and an independent Monte Carlo simulation (MCS).

Session V:

TRACK 3 - Case Studies

INVITED TALK

Indigenous Technology & Product development for Multi mode Radar (MMR) of Indian LCA -Tejas

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DPD(Avionics Systems), ADA, Bangalore, India

PLMSS06078

A Cost Effective Tool for Product Document Management

I. Aravinda Kumar

PLMSS06094

Demystifying Product Lifecycle Management

J.P. Sahu, Suryakumar, S., Karunakaran, K.P

PLMSS06097

Customized Software For Power House Structures

Hemanth Malhotra, Pradeep Mishra, Gourav Kumar Rusia

A Cost Effective Tool for Product Document Management

I. Aravinda Kumar

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Abstract: This paper presents a software tool (ProductDocument Management module for PDM system) aimed at enabling Small and Medium Enterprises (SMEs), working in the mechanical sector, to cooperate in a distributed engineering environment. SMEs are usually characterised by well established knowledge on specific component but usually do not have all the capacities to develop the complete product and to lead whole project. So for their nature they adopt co-design principle by using PDM (Product Data Management), while maintaining full autonomy. This software increase SMEs scope & flexibility to innovate new products, co-operate (exchange information in the form of documents) within the enterprise and with other enterprises. Often the cooperation implies not only a simple made-to-order development but also a real collaboration among the companies in the definition of the new product. This paper aims at understanding a general document management system and suggests a solution that can be considered while implementing a PDM solution. The presented Document Management System software includes all facilities like Check-In, Check-Out, Iteration & Version management, file attachments (like Word documents, CAD files etc.), Viewing the attached files, URL support, History Management. All the related contents like drawings, technical data can be attached to “Document”. Required document can be referenced while a processing a part object. Thus, the emphasis is given to the product specification possibly by Data reuse and to negotiation activity usually carried out to identify the right project partner.

Demystifying Product Lifecycle Management

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Customized Software For Power House Structures

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