

EXPERIMENTAL MECHANICS

New Trends and Perspectives

J.F. Silva Gomes, Mário A.P. Vaz
Editors



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2780	SALT: THE CONTRIBUTION OF INDUSTRIAL DESIGN IN THE REDUCTION AND STANDARDIZATION OF CONSUMPTION. Maria F. Silva, Pedro A. Moreira, Teresa M. Duarte, Patricia Padrão, Olivia Pinho, Luís Amaro.	681
3113	REENGINEERING THE CONCEPT OF URBAN CARS: A CASE STUDY. Irene Carvalho, António Araújo, Randolph Kirchain, Ricardo Simões, Arlindo Silva.	683
2995	CASE STUDY: DESIGN FOR MANUFACTURING - EMBRAER-EVORA COMPOSITES ASSEMBLY LINE. Daniel C. Silva, Gustavo B. Guimarães, António R. Lima Jr., Fábio S. Zenebon, André B.C. Carvalho.	685
2996	CASE STUDY: LEAN CONCEPTS - EMBRAER-EVORA WING ASSEMBLY LINE. André B.C. Carvalho, Daniel C. Silva, Gustavo B. Guimarães, José C. Mantovani Jr., Júlio C.S. Araújo.	687
2676	A GOLF BALL PICKING ROBOT DESIGN AND DEVELOPMENT. Nino Pereira, Fernando Ribeiro, Gil Lopes, Dan Whitney, F. Jorge Lino.	689
2659	SOME CONSIDERATIONS ABOUT THE USE OF TITANIUM SCREWS. Dario Croccolo, Massimiliano DeAgostinis, Nicolò Vincenzi.	691
2932	DESIGN SILICONE MOLDS FOR MANUFACTURING CERAMIC MICROCOMPONENTS. Jorge Lino, Adalberto Silva, Teresa Duarte, Susana Olhero, José M.F. Ferreira.	693
3852	THE STRATEGY FOLLOWED DURING THE IDENTIFICATION CHARACTERISTICS OF THE PRODUCT IN HIGH VOLUME PRODUCTION. Remigiusz Labudzki.	695
2607	NOVEL DESIGN CONCEPT OF MAGNETORHEOLOGICAL DAMPER IN SQUEEZE MODE. Ali A. Alghamdi, A.G. Olab.	697
2658	STRESS CONCENTRATION FACTORS AT THE ROUNDED EDGES OF A SHAFT-HUB INTERFERENCE FIT. Dario Croccolo, Massimiliano DeAgostinis, Nicolò Vincenzi.	699
2769	APPLICATION OF SYNCHRONOUS SPINNING TECHNIQUE TO TRUNCATED-PYRAMIDAL-SHAPED METAL FORMING PRODUCTS. Ichiro Shimizu, Shuuichi Tanaka.	701
2812	DYNAMIC ANALYSIS OF AUTOMOTIVE GAGE PANEL. Alexander Janushevskis, Anatoly Melnikovs, Anita Gerina-Ancane, Janis Janusevskis.	703
2999	NUMERICAL AND EXPERIMENTAL ANALYSIS OF THE SINGLE POINT SHEETS INCREMENTAL FORMING PROCESS. Virgilio Fontanari, Matteo Benedetti, Stefania Bruschi, Antonio Fuganti.	705
2977	EXPERIMENTAL ANALYSIS OF AXIAL THRUST IN CENTRIFUGAL PUMPS. Vasant Godbole, Rajashri Patil, S.S. Gavade.	707
SYMP_06: NON-DESTRUCTIVE TESTING OF ADVANCED JOINING TECHNIQUES		709
2770	INSPECTION OF INTERNAL DEFECTS IN CFRP CIRCULAR TUBES BY THREE-DIMENSIONAL DIGITAL IMAGE CORRELATION METHOD. Wei-Chung Wang, Yao-Tang Chou, Ho-Yi Chieh, Jheng-Sian Wang.	711
2927	3D DIGITAL IMAGE CORRELATION USING A SINGLE HIGH-SPEED CAMERA FOR OUT-OF-PLANE DISPLACEMENTS AT HIGH RATES. Mark Pankow, Brian Justusson, Anthony Waas, Chian-Fong Yen.	713
2695	DETERMINATION OF THE STRAIN DISTRIBUTION IN ADHESIVE JOINTS USING FIBER BRAGG GRATING SENSORS. P.M.G.P. Moreira, Lucas F.M. Silva, A.L.D. Loureiro.	715
3043	EFFECT OF CURE TEMPERATURE ON THE GLASS TRANSITION TEMPERATURE OF AN EPOXY ADHESIVE. R.J.C. Carbas, E.A.S. Marques, A.M. Lopes, Lucas F.M. Silva.	717

PAPER REF: 2812

DYNAMIC ANALYSIS OF AUTOMOTIVE GAGE PANEL

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ABSTRACT

Initial design of mechanical products nowadays extensively utilizes simulation models which allow fast design procedure. In this work automotive gage panel (GP) is designed based on Finite Element Model (FEM). The stationary and transient behaviors of the gage panel under dynamic excitations as well as stress distribution under static loading are investigated. Dynamic behavior of the gage panel is obtained by solution of the full FEM models in case of random excitations as well as *polyharmonic loading*. The results of numerical experiments are used for metamodel based GP frame bracket shape optimization.

INTRODUCTION

Always actual is a problem of safe and environmentally friendly engineering object development which has high functional properties, attractive style and competitive price. Automotive gage panels must meet many requirements (Janushevskis, 2011) starting with appropriate styling and precisely measurable functional characteristics such as stiffness, weight, accuracy, stress and deformation levels under different loading conditions, eigenfrequencies, etc. In this work mechanical design of automotive GP is discussed.

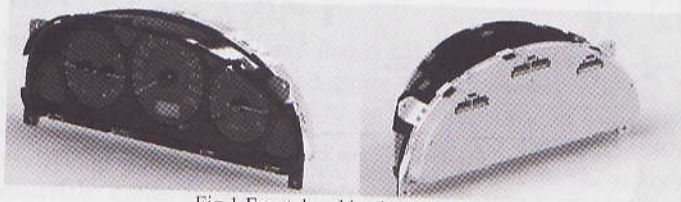


Fig.1 Frontal and back view of GP



Fig.2 - Frontal and back view of meshed GP model

In Fig. 1 we can see the initial 3D model of GP design for a passenger car. The meshed 3D model (~360000 DOF) is shown in fig. 2. It is used for FEM analysis to evaluate different responses of the GP: maximal von Mises stress in material from impact loading; maximal displacements and accelerations at characteristic points of GP in stationary and transient vibration processes due to polyharmonic excitations as well as dispersions of appropriate vibrational characteristics in case of random excitations; natural frequencies of the GP; and

finally the carbon footprint and other environmental impacts of the GP throughout its entire lifecycle.

RESULTS AND CONCLUSIONS

The initial results of dynamic analysis of the GP are presented. The responses are calculated at characteristic points of GP devices. Random excitation in 10-850 Hz frequency range (Fig. 3a) is considered. The power spectral densities of accelerations (Fig. 3b) and displacements (Fig. 3c) of characteristic points are found. Harmonic analysis (Fig. 4a, 4b) also shows significant resonance on fundamental frequency (77 Hz) that causes excessive vertical displacements and accelerations. The obtained results are used for the metamodel based (local polynomial (Auzins, 2007), kriging (Janusevskis, 2010)) GP shape optimization (Bendsoe, 2003).

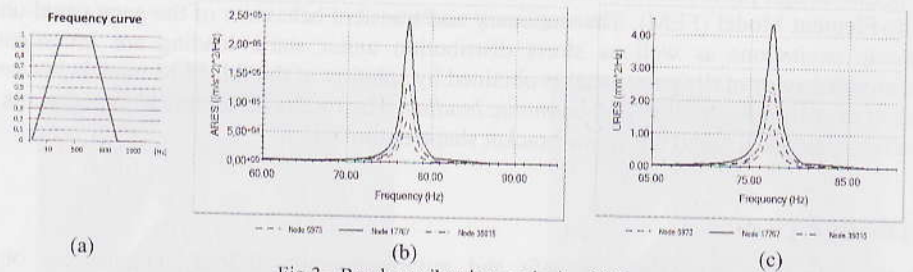


Fig.3 - Random vibration analysis of GP

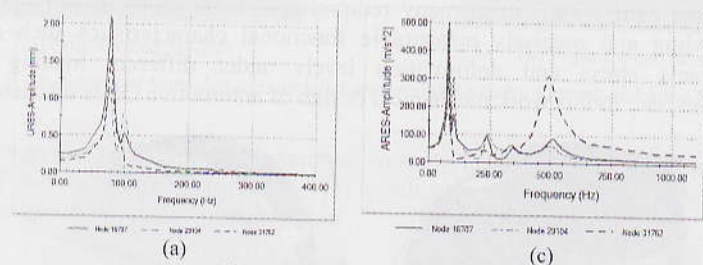


Fig.4 - Harmonic analysis of GP

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About the Book

Engineering practice in general and mechanical design in particular are basically exercises of creativity, triggered by specific needs. Different tools are available to optimize any engineering solution, from which *Experimental Mechanics* has always played a most prominent role. It is related to such diverse disciplines as physical and mechanical sciences, engineering (mechanical, aeronautical, civil, automotive, nuclear, etc.), materials, electronics, medicine and biology, and uses experimental methodologies to test and evaluate the behaviour and performance of all kinds of materials, structures and mechanical systems. Quality control, safety, destructive and non-destructive testing of materials and components, analysis of prototypes and even fundamental research are some of the possible applications of *Experimental Mechanics*. During the last few decades the development of computer based techniques, as well as laser-optics methods, nanotechnologies and nanomaterials, among many other technological advances, added new dimension and perspectives to *Experimental Mechanics and Testing*.

This volume contains the extended Abstracts of the 566 papers accepted for presentation in the ICEM15-15th International Conference on Experimental Mechanics held in Porto/Portugal, 22-27 July 2012. The book is complemented by an accompanying CD-ROM containing the full length papers.

ICEM15 is part of a prestigious series of conferences that was initiated in 1959, in Delft (The Netherlands). All these *Experimental Mechanics* meetings resulted from the belief that of those disciplines associated with advanced product design and manufacture, *experimental mechanics* techniques have been making continuous and significant advances during the years. Important and dramatic improvements in systems and component design can be made by the use of the latest advances in experimental mechanics techniques applied to energy systems, structures and materials. Their effect on the environment is significant and will help in avoiding global warming and harmful CO₂ emissions.



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