EXPERIMENTAL MECHANICS
New Trends and Perspectives

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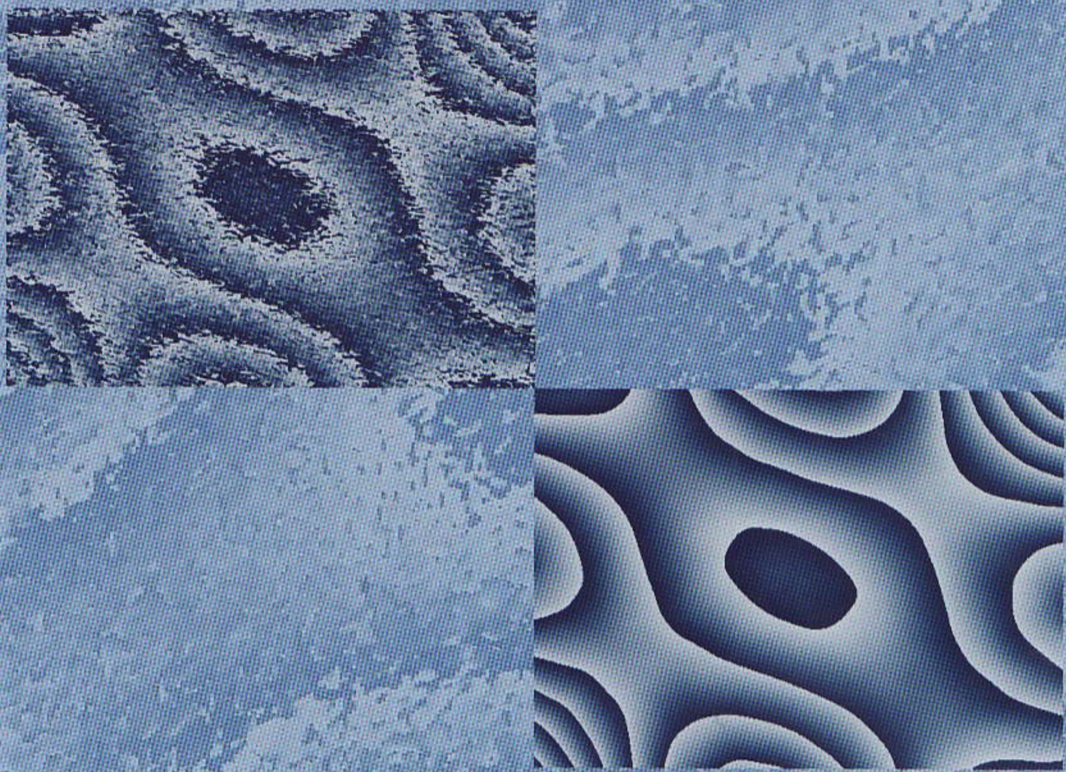

Proceedings of the 15th International Conference on Experimental Mechanics, Porto, Portugal, 22-27 July 2012

Edições INEGI

Published by

INEGI-Instituto de Engenharia Mecânica e Gestão Industrial
Rua Dr. Roberto Frias, 4200-465 Porto, Portugal
Tel:+351 22 957 87 10; Email: inegi@inegi.up.pt
www.inegi.up.pt

July, 2012

ISBN: 978-972-8826-25-3
Legal Deposit No: 343811/12

Printed by:

LusoImpress (Grupo Claret)
Rua Venceslau Ramos, s/n - 4430-929 Avintes, Portugal
Tel:+351 22 787 73 20; Fax:+351 22 787 73 29

Cover design by Nuno V. Ramos (INEGI)

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.

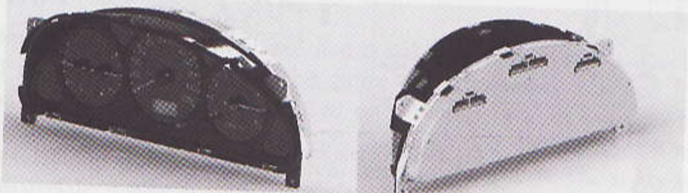


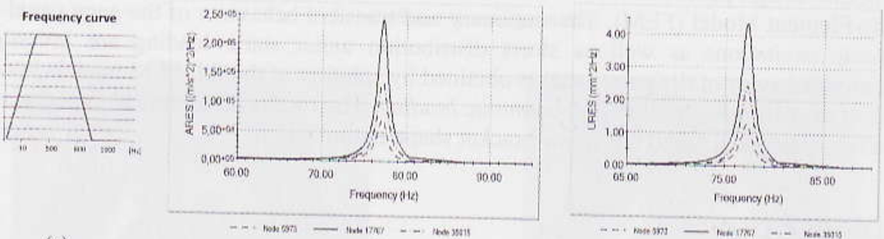
Fig.1 Frontal and back view of GP

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.

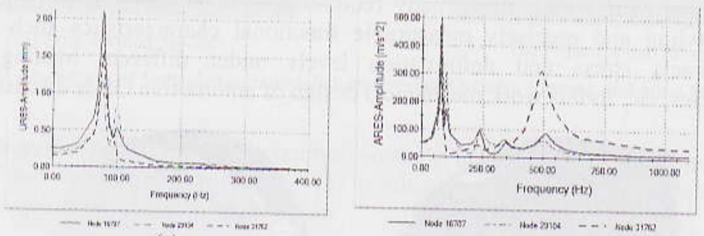
RESULTS AND CONCLUSIONS

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).



(a) (b) (c)

Fig.3 - Random vibration analysis of GP



(a) (c)

Fig.4 - Harmonic analysis of GP

ACKNOWLEDGMENTS

This work has been supported by the European Social Fund within the project No. 2009/0144/1DP/1.1.2.1.2/09/IPIA/VIAA/005 and MERPRO Ltd funding.

REFERENCES

[1]-Janushevskis A., et al., (2011). Multiobjective Optimization of Automotive Vehicle Gage Panel. 10th International Conference on Vibration Problems. September 5-8, 2011, Prague, Czech Republic. Ed. S.Segla, J.Tuma, I.Petrikova, L.Pesek. ISBN 978-80-7372-759-8. pp. 180-185.

[2]-Janushevskis A., et al., (2011). Designing of Automotive Vehicle Gage Panel. Proceedings of 9th International Conference on Advanced Manufacturing Systems and Technology. AMST''11, 16-17 June, 2011, Rijeka (Croatia), Udine (Italy), Edited by Elso Kuljanic. CIP 120909033. ISBN-978-953-6326-64-8. pp. 507-518.

About the Book

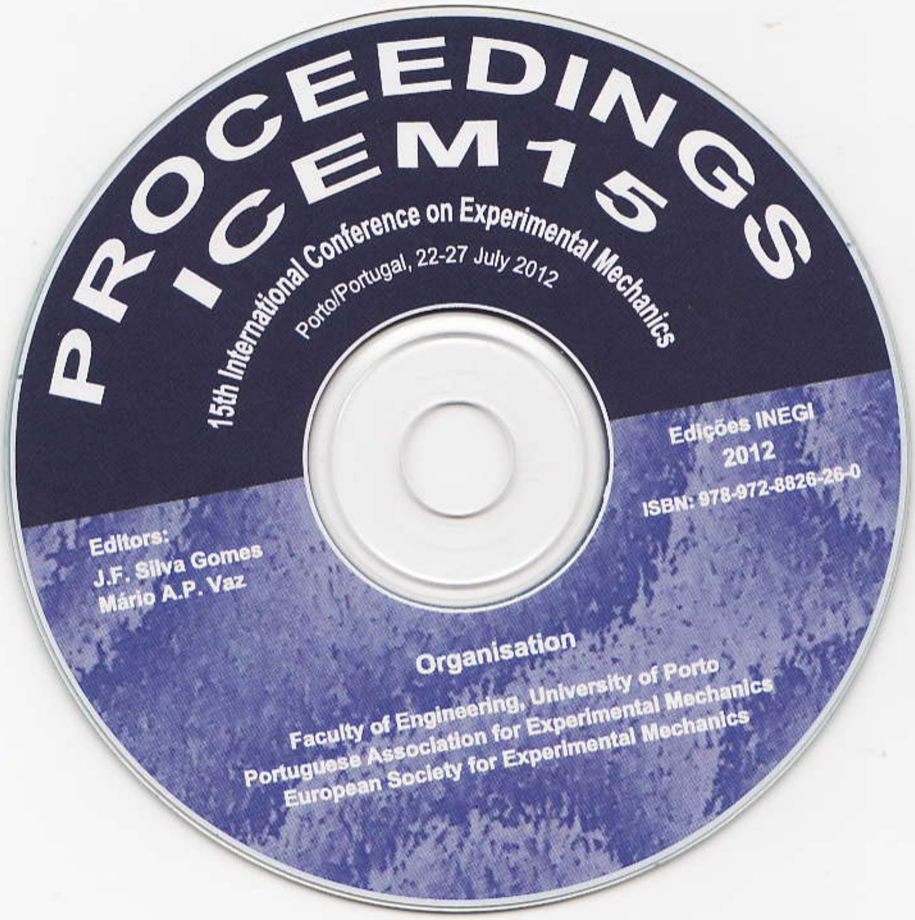
Engineering practice in general and mechanical design in particular are basically exercises of creativity, triggered by specific needs. Different tools are available to optimize any engineering solution, from which *Experimental Mechanics* has always played a most prominent role. It is related to such 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 CO_2 emissions.

ICEM15
Porto/Portugal
2012

ISBN: 978-972-8826-25-3


PROCEEDINGS
ICEM15
15th International Conference on Experimental Mechanics
Porto/Portugal, 22-27 July 2012
Edições INEGI
2012
ISBN: 978-972-8826-26-0
Editors:
J.F. Silva Gomes
Mário A.P. Vaz
Organisation
Faculty of Engineering, University of Porto
Portuguese Association for Experimental Mechanics
European Society for Experimental Mechanics