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Proceedings of the Tenth International Conference on Computational Structures Technology

Edited by
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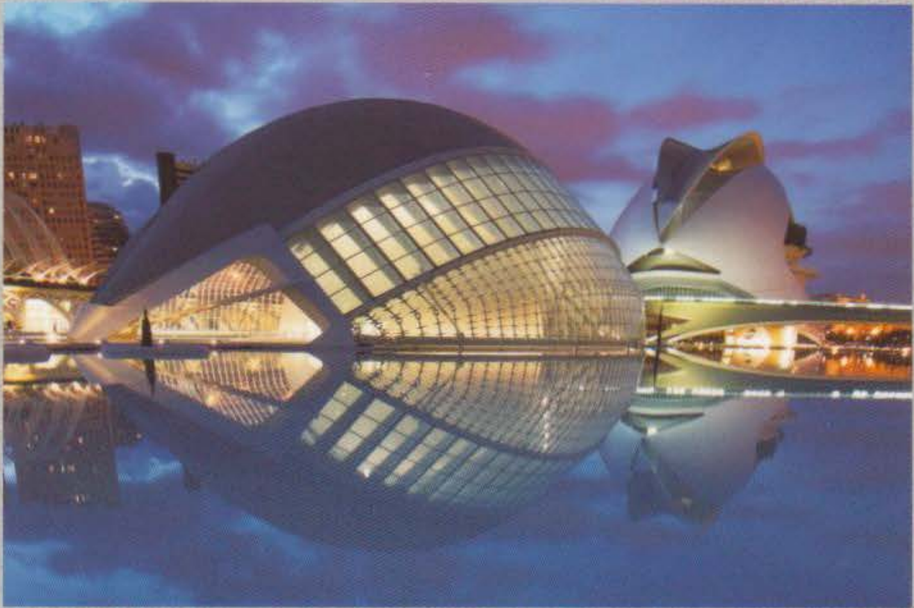

Valencia - Spain
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Including special sessions organised by:
J. Pombo, L. Baeza, Z. Dimitrovová, J.V. Araujo dos Santos, H.M.R. Lopes, C.M. Mota Soares, I. Paya-Zaforteza, J. Turmo-Coderque, L.F. Costa Neves, J.F. Aguilar Madeira, H. Pina, J.M. Adam, F.J. Pallarés, H.A. Mang, R.C. Barros, A. Baratta, A. Elhami, S. Ilanko, I. Doltsinis, V. Dias da Silva, K. Marti, G.I. Schuëller, T. Vietor, H. Irschik, S. Dumont, F. Lebon, M.L. Romero, D. Oliveira, C. Pellegrino, A. Eriksson, C.N. Chen, P.H. Kirkegaard and A.V. Singh

This book contains the summaries of the contributed papers presented at the Tenth International Conference on Computational Structures Technology, held in Valencia, Spain, 14-17 September 2010.

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Paper 54

Damage Localisation in Beams using the Ritz Method and Speckle Shear Interferometry

J.V. Araújo dos Santos[1], **H.M.R. Lopes**[2], **J. Ribeiro**[2], **N.M.M. Maia**[1] **and M.A. Pires Vaz**[3]

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Keywords: damage detection, Ritz method, Timoshenko beam theory, rotation field, spatial derivative, shear interferometry.

Structural damage identification methods have attracted the interest of mechanical, civil and aerospace engineering communities during recent decades. This interest is attested by the extensive number of papers, reviews and conferences dedicated to this area [1]. The underlying idea amongst most of these methods is that whenever there is damage in a structure, its stiffness, mass and damping properties change, therefore changing its dynamic behaviour.

In this paper a novel numerical-experimental technique is developed in order to minimise some of the difficulties exhibited by others damage localisation approaches, namely those based on the mode shape curvature [2,3]. These difficulties are: (1) ineffective differentiation schemes, (2) lower spatial resolution, and (3) presence of noise in measurements. The first difficulty is addressed by using the Ritz method and Timoshenko theory, so that one is able to compute the undamaged rotation field as a function series, and, therefore, the differentiation can be performed analytically. The damaged rotation field is obtained experimentally by speckle shear interferometry, which is a full-field technique, and the differentiation is performed using an efficient Gaussian function derivative [4]. By combining both techniques, *i.e.* the Ritz method with the speckle shear interferometry, a point-by-point correlation of rotation fields and their spatial derivatives can be performed. The last problem is addressed by applying filters to the experimental data [4].

Two damage localisation indicators are also presented, which, instead of being based on the second spatial derivative of displacement fields, are based on the first spatial derivative of the rotation fields. These damage localisation indicators, the modified curvature difference (MCD) and the modified damage index (MDI), were applied successfully in the localisation of damage in two clamped-clamped aluminium beams, using only the first mode. The proposed indicators also correlate well with the damage severity, therefore showing that they may be suitable to quantify the damage.

References

[1] J.V. Araújo dos Santos, N.M.M. Maia, C.M. Mota Soares, C.A. Mota Soares, "Structural Damage Identification: A Survey", in B.H.V. Topping, M. Papadrakakis, (Editors), "Trends in Computational Structures Technology", Saxe-Coburg Publications, Stirlingshire, UK, Chapter 1, 1-24, 2008. doi:10.4203/csets.19.1

[2] A.K. Pandey, M. Biswas, M.M. Samman, "Damage Detection from Changes in Curvature Mode Shapes", Journal of Sound and Vibration, 145(2), 321-332, 1991.

[3] N. Stubbs, J.T. Kim, C.R. Farrar, "Field Verification of a Nondestructive Damage Localization and Severity Estimation Algorithm", in "Proceedings of the 13th International Modal Analysis Conference", Nashville, U.S.A., 210-218, 1995.

[4] H.M. Reis Lopes, J.V. Araújo dos Santos, C.M. Mota Soares, R.J. Miranda Guedes, M.A. Pires Vaz, "A Numerical-Experimental Method for Damage Location Based on Rotation Fields Spatial Differentiation", Computers and Structures (Accepted for publication).