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Localization of Damage in Beams Using Interferometric Techniques

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Two interferometric techniques and their applications in structural damage identification are presented in this paper. Out-of-plane displacement fields of modal response are measured with a pulsed electronic speckle pattern interferometric system (ESPI). The modal rotation fields, defined as the spatial derivative of the displacement field, are measured with a pulsed speckle shearography system. The measurements using these two interferometric systems are compared with measurements from experimental modal analysis and results from finite element analysis. This comparison shows that these two interferometric techniques, which allow non-contact, full-field measurements, are well suited to the measurement of modal response. A damaged beam with free-free boundary conditions is analyzed. The damages studied are small cuts perpendicular to the beams longitudinal axis. The bending moments and shear forces, which are related to the second and third order spatial derivatives of the modal displacement field, in the undamaged and damaged states are computed using numerical differentiation techniques. The damage is localized by looking for maximum values and/or perturbations of damage indicators based on bending moments and shear forces along the beam. The pulsed speckle shearography system leads to a significant improvement in the computation of bending moments and shear forces and, therefore, better damage localizations than the ones obtained with the pulsed ESPI system.

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