Comparative study of orthogonal decomposition of surface deformation in composite automotive panel.

Model validation is a major step in achieving computational models with good predictive capabilities. It is normal practice to validate simulation models by comparing their numerical results to experimental data. An important issue of the validation procedure is the identification of effective techniques to perform data compression. Recently, image decomposition techniques have successfully been applied in a laboratory environment to condense data and extract features of surface deformation maps obtained with the aid of optical measurement techniques or finite element analysis [1]. In the current work, orthogonal decomposition techniques are investigated further with the aim to find an optimal approach for industrial applications. The challenges faced include working with complex surface geometries of engineering components, which usually include protrusions or cut-outs, and obtaining equivalent outputs from experiment and simulation for the purpose of subsequent model validation. Three approaches are evaluated with respect to these challenges: Principal Component Analysis [2], Advanced Geometric Moment Descriptors [3] and Patchwork, e.g. image decomposition applied to tiles [4]. To illustrate and assess the application of these approaches a case study of a composite car bonnet liner [5] subject to impact loading was used. Displacement fields from the entire surface of the bonnet liner were captured at equal time increments for 0.1s following the impact and then decomposed using the above techniques. As a result, a comprehensive review of each technique is presented and an efficient solution proposed. It is anticipated that the outcomes of this investigation will inform current efforts in data management and in developing a robust validation methodology for industrial applications.

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