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Comparison of Validation Metrics Using Repeated Full-scale Automobile Crash Tests

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ABSTRACT

Qualitatively comparing the shapes of time histories to validate experiments with computational simulations is a common technique in both general computational mechanics as well as computational roadside safety. Qualitative comparisons, however, are subjective and open to interpretation. A variety of quantitative metrics are available for comparing time history data as well but developing acceptance criteria for these methods often relies on equally imprecise engineering judgment.

This paper presents the results of time-history comparisons of 10 essentially identical full-scale vehicle re-directional crash tests with a vertical concrete wall. Five of the crash tests used exactly the same type of vehicle whereas the other five used a similar vehicle that was within the EN1317 test vehicle specifications for that class of vehicle. A variety of quantitative shape comparison metrics were calculated for each set of repeated crash test cases and the results are presented. The results are compared and contrasted as to the utility of each metric and its diagnostic value in assessing the degree of comparison between the repeated crash test time histories.

Since the crash test experiments are as identical as can be achieved experimentally, the values of the quantitative metrics represent the reasonable range for the metric corresponding to matched experiments. Statistical analysis of the data will also be performed to assess the typical residual errors that can be expected in full-scale roadside safety crash tests. Finally, recommendations for the use of specific metrics are provided.

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