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CAN WE SEPARATE INDIVIDUAL VARIABILITY FROM EXPERIMENTAL NOISE ? A SENSITIVITY STUDY OF MIXED-EFFECTS MODELS.

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Numerical models for virtual testing typically involve several parameters that must be calibrated in the presence of experimental uncertainties. Usually, the uncertainties correspond to experimental noises or model bias. In the case of composites additionally, material variability proves to be significant and international standards impose numerous test repetitions to estimate its consequences. We propose to characterize the material variability using the mixed-effects approach [1]. In the mixed-effects method, it is assumed that the material parameters of each specimen are distributed according to a joint probability distribution (*e.g.,* a multivariate normal distribution). This distribution describes the effects of material variability on the effective parameters. The objective is to determine by likelihood maximization the optimal value of the probability distribution. This approach allows to infer both the parameters distribution and the individual parameter values (the set of model parameter values characterizing each specimen). Yet, the estimation of the material variability and of the individual parameters depends on the assumption made on the model parameters distribution. In particular, we study the choice of the marginals and covariances between parameters governed by a multivariate normal distribution. The consequences of these assumptions are closely related to the number of available tests. A limited number of test repetitions strongly constrains which variability coefficient can be identified. To perform this study, a multi-scale elastic model is calibrated with laminates made from T700GC/M21 base ply material under different assumptions for the parameters distribution (*eg.* choice of the marginals, coupling parameters or not, *etc.*). The calibrated distributions are propagated through an open-hole plate model to compute a failure criterion. The resulting distributions of the failure criteria are compared to analyze the consequences of the hypotheses. In particular, the ability of mixed-effects models to extract information about individual variability from noisy data is investigated. This analysis is performed using virtual data considering different assumptions of experimental errors and specimen variability.

REFERENCES

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