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"SYSID#3 - Identification of the Payne effect in a viscoelastic material coupling Bayesian identification and Digital Twin"

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The Payne or Fletcher-Gent effect is a particular behavior occurring in viscoelastic materials containing fillers. It induces a nonlinear dependency of the viscoelastic storage modulus on the amplitude of the applied strain. This amplitude dependency must be taken into account in engineering applications as it does change the elastodynamic behavior of the overall structure integrating the material. A methodology is developed in the proposed work to identify this nonlinear effect. The approach first starts with the identification by Bayesian inference of the frequency and damping properties of a viscoelastic sample. The input data are obtained from a modified Oberst test, conducted for different displacement load amplitudes. A digital twin of the experimental set-up is then used to evaluate the stiffness behavior, and in particular the Young's modulus of the material, at the measured frequencies, and to deduce the strain level within the sample. This work shows that the Payne effect, which leads to the decrease with the amplitude of the Young's modulus, can thus be estimated in terms of mean and standard deviation by combining experiments and numerical simulations.

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