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A Bayesian Parameter Identification Method for Thermorheological Complex Materials

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Abstract : Polymers increasingly gained interest in construction materials over the last years in civil engineering applications. As polymeric materials typically show time- and temperature dependent material behavior, which is accounted for in the context of the theory of linear viscoelasticity. Within the context of this paper, the authors show, that some polymeric interlayers for laminated glass can not be considered as thermorheologically simple as they do not follow a simple TTSP, thus a methodology of identifying the thermorheologically complex constitutive bahavioir is needed. 'Dynamical-Mechanical-Thermal-Analysis' (DMTA) in tensile and shear mode as well as 'Differential Scanning Caliometry' (DSC) tests are carried out on the interlayer material 'Ethylene-vinyl acetate' (EVA). A navoel Bayesian framework for the Master Curving Process as well as the detection and parameter identification of the TTSPs along with their associated Prony-series is derived and applied to the EVA material data. To our best knowledge, this is the first time, an uncertainty quantification of the Prony-series in a Bayesian context is shown. Within this paper, we could successfully apply the derived Bayesian methodology to the EVA material data to gather meaningful Master Curves and TTSPs. Uncertainties occurring in this process can be well quantified. We found, that EVA needs two TTSPs with two associated Generalized Maxwell Models. As the methodology is kept general, the derived framework could be also applied to other thermorheologically complex polymers for parameter identification purposes.

Keywords : bayesian parameter identification, generalized Maxwell model, linear viscoelasticity, thermorheological complex
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