Mechanical performance of architected interpenetrating phase composites: Experimental, numerical and machine learning analysis

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Abstract

Interpenetrating phase composites (IPCs) based on architected media allow for mechanical properties well beyond the bounds of their constituent phases. The arising mechanical response depends on a series of underlying influential design features, which include the material properties of the phases involved, their architectural design, their volume fraction, as well as loading-related parameters, such as the strain-rate of the loading. In the current contribution, extensive numerical and experimental insights on the dependence of the effective composite material performance on the aforementioned design parameters are provided for different IPC materials that include polymer and soft matrix phase composites (1, 2). The data are used as a reference for the development of dedicated tree and deep learning modeling architectures that can not only accurately capture the effective composite performance but also be used as surrogate models for subsequent explainability analysis tasks. In particular, dedicated high-accuracy and low computational cost machine learning models are elaborated and employed to assess the significance of the underlying influential design parameters, as well as their interaction, classifying their importance for different base material combinations and loading scenarios.

REFERENCES
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