A GENERIC guided approach to learning entropy-based constitutive equations for polymeric liquids using PINNs

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Abstract: We present a GENERIC guided approach using PINNs to determine the entropy leading to the constitutive equation for the stress in rheological models. Our methodology uses the eigenvalue decomposition of the evolution equation of the conformation tensor to instill physical knowledge into a neural network approximation of the real function. Despite the PINNs model is trained on the steady-state line, its safe extrapolation limits are studied in complex flows away from the model steady-state line. We thus evaluate the error in the model predictions of the entropy and the stress in the region covered by simulations of complex flow around a cylinder at moderate Wi numbers, by comparing the results with traditional rheological models.