Title:	A Coupled Map Lattice Model for Rheological Chaos in Sheared Nematic Liquid Crystals
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Abstract:	A variety of complex fluids under shear exhibit complex spatio-temporal behaviour, including what is now termed rheological chaos, at moderate values of the shear rate. Such chaos associated with rheological response occurs in regimes where the Reynolds number is very small. It must thus arise as a consequence of the coupling of the flow to internal structural variables describing the local state of the fluid. We propose a coupled map lattice (CML) model for such complex spatio-temporal behaviour in a passively sheared nematic liquid crystal, using local maps constructed so as to accurately describe the spatially homogeneous case. Such local maps are coupled diffusively to nearest and next nearest neighbours to mimic the effects of spatial gradients in the underlying equations of motion. We investigate the dynamical steady states obtained as parameters in the map and the strength of the spatial coupling are varied, studying local temporal properties at a single site as well as spatio-temporal features of the extended system. Our methods reproduce the full range of spatio-temporal behaviour seen in earlier one-dimensional studies based on partial differential equations. We report results for both the one and two-dimensional cases, showing that spatial coupling favours uniform or periodically time-varying states, as intuitively expected. We demonstrate and characterize regimes of spatio-temporal intermittency out of which chaos develops. Our work suggests that such simplified lattice representations of the spatio-temporal dynamics of complex fluids under shear may provide useful insights as well as fast and numerically tractable alternatives to continuum representations.
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