Multiscale Simulation of Ink Seepage into Fibrous Structures through a Mesoscopic Variational Model

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Abstract : This work presents a new three-dimensional variational model proposed for the simulation of ink seepage into paper sheets at the fiber level. The model, inspired by the Hising model, takes into account a finite volume of ink and describes the system state through gravity, cohesion, and adhesion force interactions. At the mesoscopic scale, the paper substrate is modeled using a discretized fiber structure generated using a numerical deposition procedure. A modified Monte Carlo method is introduced for the simulation of the ink dynamics. Besides, a multiphase lattice Boltzmann method is suggested to fine-tune the mesoscopic variational model parameters, and it is shown that the ink seepage behaviors predicted by the proposed model can resemble those predicted by a method relying on first principles.

Keywords : fibrous media, lattice Boltzmann, modelling and simulation, Monte Carlo, variational model
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