Three-dimensional reconstruction of resin flow using data assimilation during a liquid composite molding process

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Liquid composite molding (LCM) is a method to manufacture fiber-reinforced composites, where dry fabric reinforcement is impregnated with a resin in a molding apparatus. However, the inherent process variability changes resin flow patterns during mold filling, which in turn may cause void formation. We propose a method to reconstruct three-dimensional resin flow in LCM, without embedding sensors into the composite structure. Electric measurements and the stochastic simulation of resin flow by means of the Karhunen–Loève expansion of the permeability field. are integrated by a sequential data assimilation method based on the ensemble Kalman filter; then, three-dimensional resin flow and permeability distribution are estimated simultaneously. The applicability of this method is investigated by numerical experiments, characterized by different spatial distributions of permeability. We confirmed that changes in resin flow caused by spatial permeability variations could be captured and the spatial distribution of permeability, although it is not explicitly related to the observation, can be estimated by the proposed method.