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The Representer Method for Data Assimilation of Two-Phase Flow in Porous Media

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Advances in instrumenting and imaging the subsurface are yielding large data sets, making data assimilation vital to modeling flow through porous media. We derive and implement the representer method applied to the oil/water model for reservoirs, a nonlinear model. The representer method, like the Kalman filter, solves the Euler-Lagrange (E-L) system for the minimizer of a least-squares functional of the misfit between the model and measurements. Because the representer method uses the superposition principle, a nonlinear model requires linearization of the E-L system. A key concern is finding a linearization that converges appropriately. We show that convergence is strongly affected by the choice of weights in the least-squares functional. We also compare the effects of linearization and the computational costs of the representer method with the ensemble Kalman filter.