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Double Nonlinear Diffusion Equations in a Two-Component Domain

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A system of two doubly nonlinear diffusion equations acting on two different rectangles in $\mathbb{R}^2$, connected by nonlinear boundary conditions on the contact line, is studied. The goal is to present numerical simulations of this coupled problem. We use a conservative finite-volume discretization in space and fully implicit time stepping with adaptive step sizes and adaptive damping. The interface condition is approximated by a penalty formulation. The resulting nonlinear system is solved by Newton's method with an analytic Jacobian. The experiments show close agreement with a validated explicit scheme with approximately half the computational time, successful computation of a stiff case that the explicit scheme cannot handle, and long-time relaxation with a stable interface jump.

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