A discontinuity-cusp capturing neural network for unsteady Stokes interface problems

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This talk first reviews the foundation of a discontinuity- and cusp-capturing physics-informed neural network (PINN) for solving static Stokes interface problems based on the traction balance formulation. The network consists of two fully connected sub-networks (one for the pressure and the other for the velocity vector), and both sub-networks share the same coordinate inputs but use distinct augmented feature inputs derived from a presumed level set function presenting the interface position. This strategy effectively and accurately captures the pressure discontinuities and the cusp-like velocity profile at the interface. In the second part, we consider the unsteady Stokes interface problems mainly driven by the interfacial tension. Here, the augmented feature inputs are time-dependent and varied by a level set function following an advection equation. We conduct numerical experiments for two- and three-dimensional Stokes interface problems, comparing the accuracy of our method with augmented immersed interface methods. We also present the simulation of droplet dynamics under a given initial flow.