# A Particle-Field Algorithm with Neural Interpolation for a Parabolic-Hyperbolic Chemotaxis System in 2 Space Dimensions

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## Abstract:

Many biological phenomena involve interactions between individual bodies such as proteins (particles) and a pervasive environment (field). Specifically, angiogenesis involves a tumor moving towards blood vessels for nutrients to grow. Angiogenesis, and in general chemotaxis, systems have been modeled using partial differential equations (PDEs) and as such require numerical methods to approximate their solutions. Here we study a Parabolic-Hyperbolic Keller-Segel (PHKS) system in 2 space dimensions. The model arises in the angiogenesis literature. To compute solutions to the PHKS system, we develop a neural stochastic interacting particle-field (NSIPF) method where the density variable is represented as empirical measures of particles and the field variable (concentration of chemo-attractant) approximated by a convolutional neural network (CNN). We discuss the performance of NSIPF in computing multi-bump solutions to the system and its potential to generalize to higher dimensions.

## Keywords:

Neural interpolation, parabolic-hyperbolic chemotaxis, stochastic particle field method, self-similar solutions.