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Mean field limit of interacting filaments and vector valued non linear PDEs

Families of N interacting curves are considered, with long range, mean field type, interaction. They generalize models based on classical interacting point particles to models based on curves. In this new set-up, a mean field result is proven, as $N \rightarrow \infty$. The limit PDE is vector valued and, in the limit, each curve interacts with a mean field solution of the PDE. Our main motivation is the approximation of 3D-inviscid flow dynamics by the interacting dynamics of a large number of vortex filaments, as observed in certain turbulent fluids; in this respect, the present result is restricted to smoothed interaction kernels, instead of the true Biot-Savart kernel.