Limits of non-local approximation to the Eikonal equation on manifolds

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We consider a non-local approximation of the time-dependent Eikonal equation defined on a Riemannian manifold. We show that the local and the non-local problems are well-posed in the sense of viscosity solutions and we prove regularity properties of these solutions in time and space. If the kernel is properly scaled, we then derive error bounds between the solution of the non-local problem and the one of the local problem, both in continuous-time and Forward Euler discretization. Finally, we apply these results to a sequence of random weighted graphs with n vertices. In particular, we establish that the solution of the problem on graphs converges almost surely uniformly to the viscosity solution of the local problem as the kernel scale parameter decreases at an appropriate rate as the number of vertices grows and the time step vanishes.

Joint work with Nicolas Forcadel (INSA de Rouen,France) and Jalal Fadili (École nationale supérieure d'ingénieurs de Caen (ENSICAEN),France).