UNIVERSITY AT ALBANY
State University of New York

College of Arts and Sciences
Department of Mathematics and Statistics

Applied Topology in Albany (ATiA) Seminar

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Wasserstein Stability of the Nerve Map

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Abstract. Given a locally finite open cover of a paracompact space, a subordinate partition of unity defines a map into the geometric realization of the nerve, and when the cover is good, the nerve theorem says this map is a homotopy equivalence. In applied topology, one specializes to covers of metric data by balls centered at finitely many landmarks. The corresponding nerve map represents the data inside the Čech complex, enabling one to pull cohomological or spectral invariants back to the data. In this talk, I will discuss ongoing work with José Perea in which we introduce a weighted generalization of the nerve map and study its stability under perturbations of the landmarks and weights, using metrics from optimal transport. Under a uniform nondegeneracy assumption, we prove that this map is Lipschitz stable with respect to a scale-dependent refinement of the 1-Wasserstein distance, and we show our estimate is sharp. As this distance is dominated by a multiple of the 1-Wasserstein distance itself, we obtain Wasserstein stability as a corollary. We also give explicit estimates of the Lipschitz constants for closed Riemannian manifolds. Finally, time permitting, I will sketch several applications, including to the stability of Laplacian eigenvector cascading and Eilenberg–MacLane coordinates.