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Wasserstein bounds through Stein's method with bespoke derivatives

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Abstract

We revisit Stein's method in order to bound the Wasserstein-1 distance between continuous and discrete distributions. Our approach rests on a new family of discrete Stein operator obtained using bespoke discrete derivatives.

Appropriate choices of the derivatives make the continuous and discrete score functions coincide, which allows to obtain sharper bounds on the Wasserstein-1 distance. We also propose new bounds on the derivatives of the solutions of the Stein equation, in the context of Integrated Pearson distributions, which is a crucial step of Stein's method.

We apply our result to several examples of convergence, including the Central Limit Theorem, the Polya-Eggenberger urn model, the empirical distribution of the ground state of a many-interacting-worlds harmonic oscillator, and the stationary distribution of the Erlang-C system.