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On the Computation of General Constrained Wasserstein Barycenters

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This work explores constrained Wasserstein barycenters (CWB), extending the applicability of the classical Wasserstein barycenter (WB) to pre-required geometric, statistical, or constraints. While the WB problem has been extensively studied, constrained settings pose significant challenges, particularly for nonconvex constraint sets. Building upon the Method of Averaged Marginals (MAM), we propose two different algorithms with convergence guarantees and a promising heuristic method.
We first extend MAM to solve the CWB problem for convexly constrained sets, providing rigorous mathematical guarantees for exact convergence. For nonconvex constraint sets, we develop a heuristic extension of MAM, and incorporating a Difference-of-Convex (DC) model and progressive decoupling methods we ensure convergence to critical points. Finally, we evaluate the numerical performance of these methods on diverse applications, demonstrating both the computational efficiency and practical relevance of CWBs.

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