1163-49-111 **Melanie Weber*** (`mw25@math.princeton.edu`) and **Suvrit Sra**. *Riemannian Frank-Wolfe Methods and Applications.*

Many applications involve non-Euclidean data, such as graphs, strings, or matrices, where exploiting Riemannian geometry can deliver algorithms that are computationally superior to standard nonlinear programming approaches. We introduce Riemannian Frank-Wolfe (RFW) methods as a class of projection-free algorithms for constraint geodesically convex and nonconvex optimization. In contrast to the projected-gradient approaches considered in the previous literature, RFW is guaranteed to stay in the feasible region, circumventing the need to compute potentially costly projections. At the heart of RFW lies a Riemannian "linear" oracle that determines the update conditioned on geodesically convex constraints. While in general a nonconvex semi-definite problem, we discuss matrix-valued tasks where the solution can be computed in closed form. RFW extends naturally to stochastic settings, where we discuss both purely stochastic and finite-sum problems, including empirical risk minimization. We show that RFW converges at a nonasymptotic sublinear rate, recovering the best-known guarantees for its Euclidean counterpart. Finally, we discuss the computation of Riemannian centroids and Wasserstein barycenters via RFW, both of which are crucial subroutines in many machine learning methods. (Received August 29, 2020)