Riemannian optimization tools for optimal transport

Bamdev Mishra
Microsoft India
bamdevm@microsoft.com

Optimal transport or OT [PC19] has become a relevant tool in various machine learning applications. The rising popularity of OT is because it gives a principled approach in exploiting the underlying metric geometry to develop different notions of distances between probability distributions to be used in downstream applications. Consequently, there have been many works on developing computationally efficient tools to solve OT problems.

In this presentation, we look at the Riemannian approach to solving OT related optimization problems. The Riemannian approach has also got popular for solving structured nonlinear optimization problems [Bou20]. To that end, we discuss some of the recent works on exploiting Riemannian manifold structures to develop optimization-related ingredients for tackling OT formulations [HMJG22, MSKJ21]. We also look at various challenges and opportunities that lay ahead in making Riemannian tools a viable alternative for OT practitioners.

Joint work with: Andi Han, Pratik Jawanpuria, and Junbin Gao.

References

[Bou20] Nicolas Boumal, *An introduction to optimization on smooth manifolds*, Available online, Aug 2020.

[HMJG22] Andi Han, Bamdev Mishra, Pratik Jawanpuria, and Junbin Gao, *Riemannian block spd coupling manifold and its application to optimal transport*, Tech. report, arXiv preprint arXiv:2201.12933, 2022.

[MSKJ21] Bamdev Mishra, NTV Satyadev, Hiroyuki Kasai, and Pratik Jawanpuria, *Manifold optimization for non-linear optimal transport problems*, Tech. report, arXiv preprint arXiv:2103.00902, 2021.

[PC19] Gabriel Peyré and Marco Cuturi, *Computational optimal transport: With applications to data science*, Foundations and Trends® in Machine Learning **11** (2019), no. 5-6, 355–607.