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DISMA Dipartimento di Scienze Matematiche G. L. Lagrange

ECCELLENZA 2018 • 2022

Online seminar

Wednesday April 07, 2021 at 17:30
Hosted on: Zoom

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Consensus-based Optimization on the Sphere

Prof. Tosin introduces the seminar.

Abstract

I present new stochastic multi-particle models for global optimization of nonconvex functions on the sphere. These models belong to the class of Consensus-Based Optimization methods. In fact, particles move over the manifold driven by a drift towards an instantaneous consensus point, computed as a combination of the particle locations weighted by the cost function according to Laplace's principle. The consensus point represents an approximation to a global minimizer. The dynamics is further perturbed by a random vector field to favor exploration, whose variance is a function of the distance of the particles to the consensus point. In particular, as soon as the consensus is reached, then the stochastic component vanishes.

In the first part of the talk, I present the well-posedness of the model on the sphere and we derive rigorously its mean-field approximation for large particle limit. In the second part I address the proof of convergence of numerical schemes to global minimizers provided conditions of well-preparation of the initial datum. The proof combines the mean-field limit with a novel asymptotic analysis, and classical convergence results of numerical methods for SDE. We present several numerical experiments, which show that the proposed algorithm scales well with the dimension and is extremely versatile. To quantify the performances of the new approach, we show that the algorithm is able to perform essentially as good as ad hoc state of the art methods in challenging problems in signal processing and machine learning, namely the phase retrieval problem and the robust subspace detection.

A Joint work with H. Huang, L. Pareschi, and P. Sünnen

Biography

Massimo Fornasier received his doctoral degree in Computational Mathematics in 2003 from the University of Padua, Italy. After spending from 2003 to 2006 as a postdoctoral research fellow at the University of Vienna and University of Rome La Sapienza, he joined the Johann Radon Institute for Computational and Applied Mathematics (RICAM) of the Austrian Academy of Sciences, where he served as a senior research scientist until March 2011. He was an associate researcher from 2006 to 2007 for the Program in Applied and Computational Mathematics of Princeton University, USA. In 2011 he was appointed Chair of Applied Numerical Analysis at TUM.

Massimo Fornasier's research embraces a broad spectrum of problems in mathematical modeling, analysis and numerical analysis. He is particularly interested in the concept of compression as appearing in different forms in data analysis, image and signal processing, and in the adaptive numerical solutions of PDEs or high-dimensional optimization problems.

He is a member of VQR, a panel responsible for the evaluation of the quality of research in Italy. He is also a member of the editorial boards of Networks and Heterogeneous Media, Journal of Fourier Analysis and Applications and Calcolo.

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