ON THE CONVERGENCE OF CONTINUOUS-TIME MIRROR DESCENT WITH NOISY GRADIENT OBSERVATIONS

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In view of solving theoretically constrained optimization problems, we investigate the properties of an apparently new first-order method based on stochastic differential equations and ideas present in the well-known mirror descent algorithm of Nemirovski and Yudin (1983). Mirror descent (MD) is an online algorithm for solving a constrained optimization problem which has received much attention in the convex optimization and machine learning community because of its efficiency in large-scale optimization problems, and its flexibility with respect to the geometry of the feasible set. Beck and Teboulle (2003) demonstrated the intricate connection between MD algorithms and projected subgradient methods, and our research can be seen as a continuous-time stochastic extension of this line of research.

In motivating our method, we start with a random perturbation of the classical mirror descent algorithm, to be called noisy mirror descent (SMD). These perturbations are intended to take care of measurement noise of the gradient of the objective function, and residual noise. Presence of noise is a fundamental ingredient in the motivating examples for this line of research, consisting of statistical learning, game theory and, wireless communication networks. In view of future research where we use this method to global optimization problems, we can also interpret the residual noise as purposefully added randomness in order to avoid getting trapped in local minima only (as in Simulated annealing approaches).

In the first part of the talk I give an informal overview about first-order methods in mathematical programming, and their importance in optimization, statistical learning, and game theory.

The second part of the talk will consist of an outline of on-going research where this method is applied to the design of learning dynamics in repeated games in unpredictable environments.