Shape-Constrained Kernel Machines*

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Abstract

Shape constraints (such as non-negativity, monotonicity w.r.t. various partial orderings, convexity, or supermodularity) are omnipresent in statistics, economics, biology, finance, game theory, reinforcement learning and control problems. Imposing these requirements in a hard way in flexible function classes, however, is a notoriously challenging task. I will present a convex optimization framework relying on second-order cone tightening which enables one to encode hard affine shape constraints on function derivatives in reproducing kernel Hilbert spaces. The efficiency of the technique is demonstrated in the reconstruction problem of convoy trajectories, in joint quantile regression (analysis of aircraft departure trajectories) and in safety-critical control (piloting an underwater vehicle avoiding obstacles).

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