**Title:**
Density estimation in infinite dimensional exponential families

**Speaker:**
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**Time & Place:**
Wednesday, April 29, 2015, 4:00–5:00pm
Room 133 SMI
(Cookies and Coffee @ 3:30 in Rm 1210 MSC)

**Abstract:**

We consider an infinite dimensional generalization of natural exponential family of probability densities, which are parametrized by functions in a reproducing kernel Hilbert space (RKHS), and show it to be quite rich in the sense that a broad class of densities on $\mathbb{R}^d$ can be approximated arbitrarily well in Kullback-Leibler (KL) divergence by elements in the infinite dimensional family, $P$. Motivated by this approximation property, we consider the problem of estimating an unknown density $p_0$, through an element in $P$. Standard techniques like maximum likelihood estimation (MLE) or pseudo MLE (based on the method of sieves), which are based on minimizing the KL divergence between $p_0$ and $P$, do not yield practically useful estimators because of their inability to efficiently handle the log-partition function. We propose an estimator based on minimizing the Fisher divergence between $p_0$ and $P$, which involves solving a simple finite-dimensional linear system. We show the proposed estimator to be consistent, and provide convergence rates under a smoothness assumption that $\log(p_0)$ belongs to the image of the fractional power of a Hilbert-Schmidt operator defined on RKHS. Through numerical simulations we demonstrate that the proposed estimator outperforms the non-parametric kernel density estimator, and that the advantage of the proposed estimator grows with increasing dimension.

Joint work with Kenji Fukumizu, Arthur Gretton, Aapo Hyvarinen and Revant Kumar