

**MICHIGAN STATE UNIVERSITY**  
Department of Statistics and Probability

## COLLOQUIUM

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### **Another Look at DWD: Thrifty Algorithm and Bayes Risk Consistency in RKHS**

Tuesday, October 6, 2015  
10:20 a.m. - 11:10 am  
Refreshments 10:00 am  
C405 Wells Hall

#### **Abstract**

Distance weighted discrimination (DWD) is a margin-based classifier with an interesting geometric motivation. DWD was originally proposed as a superior alternative to the support vector machine (SVM), however DWD is yet to be popular compared with the SVM. The main reasons are twofold. First, the state-of-the-art algorithm for solving DWD is based on the second-order-cone programming (SOCP), while the SVM is a quadratic programming problem which is much more efficient to solve. Second, the current statistical theory of DWD mainly focuses on the linear DWD for the high-dimension-low-sample-size setting and data-piling, while the learning theory for the SVM mainly focuses on the Bayes risk consistency of the kernel SVM. In fact, the Bayes risk consistency of DWD is presented as an open problem in the original DWD paper. In this work, we advance the current understanding of DWD from both computational and theoretical perspectives. We propose a novel efficient algorithm for solving DWD, and our algorithm can be several hundred times faster than the existing state-of-the-art algorithm based on the SOCP. In addition, our algorithm can handle the generalized DWD, while the SOCP algorithm only works well for a special DWD but not the generalized DWD. Furthermore, we consider a natural kernel DWD in a reproducing kernel Hilbert space and then establish the Bayes risk consistency of the kernel DWD. We compare DWD and the SVM on several benchmark data sets and show that the two have comparable classification accuracy, but DWD equipped with our new algorithm can be much faster to compute than the SVM.

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