

**STANFORD UNIVERSITY**  
**DEPARTMENT OF STATISTICS**  
**DEPARTMENTAL SEMINAR**

4:15 p.m., Tuesday, July 8, 2008  
Sequoia Hall Room 200  
(Cookies at 3:45 in 1st Floor Lounge)

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**Reconstruction of wind wave fields by refractive imaging of water**

The study of wind waves gives insight into ocean atmosphere interaction. Despite advances in mathematical modeling of waves, experimental observation in wave tanks is still an important tool for understanding their development. We consider the problem of reconstructing the wave height and slope fields from refracted light images of the wave field. Previous authors Zhang (1996), Kimmoun et al. (1999), have proposed a two stage reconstruction algorithm: a) Local reconstruction of slopes b) Global reconstruction of heights. We show how statistical analysis can improve reconstruction quality. Our approach is based on a non-linear nonparametric observational model. Analysis under this model shows considerable heteroscedasticity and some bias in local slope estimates. These are incorporated into the global reconstruction, which is achieved using a computationally efficient minimization of a penalized weighted least squares criterion. The method is validated by simulation experiments and illustrated by application to real data.