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Graduate Mathematics Seminar

Nearly Optimal Adaptive Tests for Object Detection

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Abstract: Target detection in a cluttered environment, involving noisy measurements of signals over time, is a central problem in radar, sonar and communications applications.

We consider the problem of detecting an object in AR(p) noise assuming that the distribution of the observed data is not exactly specified, and the hypotheses to be tested are composite. We examine three procedures: (i) an adaptive version of the SPRT (sequential probability ratio test) built upon one-stage delayed estimators of the unknown signal intensity; (ii) the generalized SPRT; and (iii) the non-adaptive 2-SPRT.

The generalized SPRT has certain drawbacks in selecting thresholds to guarantee the upper bounds on the probabilities of errors but may appear to be slightly more efficient than the adaptive SPRT if the error probabilities match. However, simulations show that the loss in performance of the adaptive SPRT compared to the generalized SPRT is very minor, so the adaptive SPRT can be recommended for practical applications. The non-adaptive 2-SPRT is not asymptotically optimal for all parameter values, but rather at the worst point in the indifference zone, which is, perhaps, of less interest.

More importantly, we obtain higher order approximations to the probabilities of errors and the expected sample size for all three rules. We then perform extensive Monte Carlo simulations of the three sequential tests, evaluate their performance—including the false alarm rate, the missed detection rate, and the average time to detection—and compare it to the asymptotic approximations.

This is a joint work with D.Sc. Alexander Tartakovsky.

When: Monday, April 13, 2020, 6:00 – 7:00 pm

Location: Zoom