Cognitive Radar Detection in Nonstationary Environments and Target Tracking
PhD Dissertation Defense

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Abstract: Target detection and tracking are the most fundamental and important problems in a wide variety of defense and civilian radar systems. In recent years, to cope with complex environments and stealthy targets, the concept of cognitive radars has been proposed, which integrates intelligent modules into conventional radar systems. The cognitive radars are designed to sense, learn from, and adapt to the environments, in order to achieve better performance. In this presentation, we introduce cognitive radar for target detection in nonstationary environments and cognitive radar networks for target tracking.

For target detection in the practical scenario, changes in nonstationary environment can perturb the parameters of the clutter distribution, or even alter the clutter distribution family, which can greatly deteriorate the target detection capability. To avoid such potential performance degradation, we propose a unifying framework that integrates (i) change-point detection of clutter distributions by using a data-driven cumulative sum (CUSUM) algorithm and its extended version, (ii) learning/identification of clutter distribution using kernel density estimation methods and similarity measures (iii) adaptive target detection by automatically modifying the likelihood-ratio test and corresponding detection threshold. We conduct extensive numerical experiments to show the merits of the proposed method compared with the nonadaptive and classical methods. For target tracking, we propose a general framework for single target tracking in cognitive networks of radars, including joint consideration of waveform design, path planning, and radar selection. We formulate the tracking procedure using the theories of dynamic graphical models (DGM) and recursive Bayesian state estimation (RBSE). Further, we use an illustrative example to introduce a specific scenario in 2-D space. Simulation results based on this scenario demonstrate that the proposed framework can accurately track the target under the management of a network of radars.

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Time: 2:00 p.m.
Meeting: https://wustl.zoom.us/j/99693936041?pwd=dXYrS08vU3BvMUF4NEovOTRTbEZxZz09
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