SEMINAR NOTICE

Preston M. Green Department of Electrical and Systems Engineering

DISCRETE AND CONTINUOUS SPARSE RECOVERY METHODS FOR DIRECTIONS ESTIMATION WITH CO-PRIME ARRAYS

DISSERTATION DEFENSE

By

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Abstract: Low-dimensional signal recovery exploits the fact that many natural signals are inherently low dimensional, although they may have high ambient dimensions. Prior information about the low-dimensional space can be exploited to aid in recovery of the signal of interest and improve the performance. Signal sparsity is one of the popular forms of prior information and is the prior that underlies the field of direction of arrival (DOA) estimation.

In this work, we consider the problem of DOA estimation using a recently proposed structure of non-uniform linear arrays, referred to as co-prime arrays. Given co-prime numbers M and N, co-prime arrays exhibit $O(MN)$ degrees of freedom with only $M + N$ sensors by exploiting the second order statistical information of the received signals. We propose two sparsity-based recovery algorithms to fully utilize these degrees of freedom. The first algorithm discretizes the continuous space into a grid and exploits the joint sparsity between sparse DOAs and the off-grid parameters. A first-order fast algorithm based on this approach is proposed to achieve efficient computing. The second algorithm is based on the developing theory of super resolution, which considers a continuous range of possible sources instead of conventionally discretizing this range onto a grid. With this approach, off-grid effects inherent in traditional sparse recovery can be neglected, thus improving the accuracy of DOA estimation. We show that in the noiseless case it is theoretically possible to detect up to $MN/2$ sources with only $2M + N$ sensors. The noise statistics of co-prime arrays are also analyzed to demonstrate the robustness of the continuous optimization scheme. A source number detection method is presented based on the spectrum reconstructed from the subspace method. Through extensive numerical examples, we show the superiority of the suggested algorithms in terms of DOA estimation accuracy, degrees of freedom, and resolution ability over previous techniques, such as MUSIC with spatial smoothing.

DATE: **Monday April 20, 2015**
TIME: **2:10 pm**
PLACE: **Green Hall, Room 0120**

Dissertation advisor:
Dr. Arye Nehorai

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Washington University in St. Louis
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