EE 6880: Topics in Signal Processing - Space-time Coding and Signal Processing for Wireless Communications

Chapter 4: Space-time block coding

- Alamouti space-time block code
  - Alamouti code for two transmit antennas
  - Comparisons with receive antenna MRC and transmit antenna beamforming
  - Decoding algorithm
- STBC based on real orthogonal designs
  - The $n \times n$ real orthogonal design $\mathcal{O}_n$, encoding and decoding algorithms, full diversity order $n_T n_R$
  - Linear processing orthogonal designs
  - Hurwitz-Radon theory and existence of linear processing orthogonal designs ($\mathcal{O}_2, \mathcal{O}_4, \mathcal{O}_8$)
- Generalized real orthogonal designs
  - The $p \times n$ generalized orthogonal designs $\mathcal{G}_n$ with rate $R = k/p$, encoding and decoding algorithms, full diversity order $n_T n_R$
  - Definition and characterization of $A(R, n)$, and delay-optimality
  - Construction of full-rate generalized orthogonal designs $\mathcal{G}_n$
  - Expression for $A(1, n)$ and delay optimality of $\mathcal{O}_2, \mathcal{O}_4, \mathcal{O}_8$ and $\mathcal{G}_3, \mathcal{G}_5, \mathcal{G}_6, \mathcal{G}_7$.
- Generalized complex orthogonal design
  - The $n \times n$ complex orthogonal design $\mathcal{O}_n^c$ and construction $\mathcal{O}_n^c \longrightarrow \mathcal{O}_{2n}$
  - Existence of complex orthogonal design ($\mathcal{O}_2$ – Alamouti code)
  - Complex linear processing orthogonal designs
  - The $p \times n$ generalized complex orthogonal design $\mathcal{G}_n^c$ with rate $R = k/p$.
  - Definition and properties of $A_c(R, n)$
  - Construction of half-rate generalized complex orthogonal design $\mathcal{G}_n^c$ from $\mathcal{G}_n$
  - Rate-3/4 codes $\mathcal{H}_3$ and $\mathcal{H}_4$
  - Decoding algorithms for $\mathcal{G}_n^c$, $\mathcal{H}_3$ and $\mathcal{H}_4$
  - Performance of STBC
- Differential space-time block codes based on orthogonal designs
  - Differential Alamouti code for two transmit antennas
  - Differential STBC based on orthogonal design
- Differential STBC based on unitary group codes

- Unitary space-time codes and quadratic receiver
- Code design criteria when channel is unknown to the receiver
- Unitary group codes
- Differential receiver
- Error bounds and design criteria
- Optimal unitary group codes for $n_T = T = 2$

References:

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◇ *STBC based on orthogonal designs:*

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◇ *Differential STBC based on orthogonal designs:*

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16. H. Jafarkhani and V. Tarokh. Multiple transmit antenna differential detection from generalized orthogonal designs. *IEEE Trans. Inform. Theory*, 47(6):2626 – 2631, Sep. 2001.

◇ *Differential STBC based on unitary group codes:*

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