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Block-Sparse Impulsive Noise Reduction in OFDM Systems—A Novel Iterative Bayesian Approach.

-M. Korki, J. Zhang, C. Zhang, and H. Zayyani

- *Problem:* Mitigation of the impact of impulsive noise in OFDM systems.
- *Contribution:* Novel block-IBA Rx for optimal estimation & removal of impulsive noise.
- *Model:* $\mathbf{y} = \mathbf{FHF}^H\mathbf{x} + \mathbf{Fe} + \mathbf{Fz} = \mathbf{Dx} + \mathbf{Fe} + \tilde{\mathbf{z}}$.
  $\mathbf{e} = \mathrm{diag}\{\mathbf{s}\}\boldsymbol{\theta}$, $\mathbf{s}$: Order-1 MP p_{01}, p_{10}; $p(e_i) = p\delta(e_i) + (1-p)\mathcal{CN}(0, \sigma_\theta^2)$ [BGHMM].
- *Impulsive noise Rx:*
  $\mathbf{y}_J = \mathbf{F}_J\mathbf{e} + \tilde{\mathbf{z}}_J$,

  $$\text{Estimation of } \mathbf{e} \begin{cases} \text{MAP estimation of } \mathbf{s}\text{: } \mathbf{s}_{\mathrm{MAP}} = \arg\max_{\mathbf{s}} p(\mathbf{s})p(\mathbf{y}_J|\mathbf{s}) \\ \text{MAP estimation of } \theta \text{ using SBL: Gaussian priors on } \theta. \end{cases}$$
- *Block IBA noise estimation*:
  Estimation of $\mathbf{s}$: Search over 2^N sets- convert the problem.
  Model $\mathbf{s}$ as GM with two GVs centered around 0 and 1.
  Algo.: **E-step**: Estimation of $\boldsymbol{\theta}$ based on $\hat{\mathbf{s}}$.
  M-step: $\mathbf{s}_{\mathrm{MAP}} = \arg\max_{\mathbf{s}} \underbrace{(\log p(\mathbf{s}) + \log p(\mathbf{y}_J|\mathbf{s}))}_{L(\mathbf{s})}$

  Maximize $L(\mathbf{s})$ with steepest ascent.
- Learning model parameters $p_{01}, p_{10}, \sigma_\theta^2, \sigma_n^2$ with method of moments.

Message Passing Algorithms for Phase Noise Tracking Using Tikhonov Mixtures.

–Shachar Shayovitz and Dan Raphaeli

- *Problem:* Phase noise can limit the information rate of comm. systems, PLL unsuitable for coded systems in high phase noise.
- *Contribution:* Approach for approximating phase noise f/w and b/w messages - Tikhonov mixtures; Hypothesis expansion & clustering; Limiting instantaneous algo. complexity.
- *Model:* $r_k = c_k e^{j\theta_k} + n_k, \qquad \theta_k = \theta_{k-1} + \Delta_k.$
  Sum & Product messages computed: $p_f(\theta_k) = \int_0^{2\pi} p_f(\theta_{k-1}) \cdots$; $p_b(\theta_k) = \int_0^{2\pi} p_b(\theta_{k-1}) \cdots$
- *Background used:* Directional statistics - RVs defined on circles & spheres.
  Circular mean & variance: $\mu_C = \angle \mathbb{E}[e^{j\theta}]$, $\sigma_C^2 = \mathbb{E}[1 - \cos(\theta - \mu_C)]$; One CD: Tikhonov.
  CMVM: In KL-divergence sense, the nearest Tikhonov dist. to any circular dist. $f(\theta)$ has its circular mean & var. matched to $f(\theta)$.
- *Tikhonov mixture:* $p_f(\theta_k) \approx \sum_{i=1}^{N_f^k} \alpha_i^{k,f} t_i^{k,f}(\theta_k)$, $t_i^{k,f}(\theta_k) = \frac{e^{\Re[z_i^{k,f} e^{-j\theta_k}]}}{2\pi I_0(|z_i^{k,f}|)}$.
- *Mixture reduction:* Given a Tikhonov mixture $f(\theta)$ of order L, find a Tikhonov mixture $g(\theta)$ of order $N (< L)$ which minimizes $D_{\mathrm{KL}}(f(\theta) \| g(\theta))$.
- *Mixture reduction algo.:* Global and local algorithms; *Runnalls, Lehmann, West*.
  Adaptive mixtures: Limited # mixture components, use pilot symbols to regain tracking.

Training Sequence Design for Feedback Assisted Hybrid Beamforming in Massive MIMO Systems.

–S. Noh, M. D. Zoltowski, and D. J. Love

- *Problem:* Channel estimation in massive MIMO FDD systems is challenging; schemes are highly complex, training signal overhead is huge.
- *Contribution:* Training scheme design with reduced dimensionality of training sequence & transmit precoding; suboptimal algo. to minimize max. steady state channel MSE.
- *Model:* $y_k = \mathbf{h}_l^H \mathbf{s}_k + w_k$; block Tx with $M = M_p + M_d$ symbols; $\mathbf{s}_k = \mathbf{v}_l x_k$.
  Block fading channel: $\mathbf{h}_{l+1} = a\mathbf{h}_l + \sqrt{1-a^2}\ \mathbf{b}_{l+1}$; $\mathbf{b}_l \sim \mathcal{CN}(\mathbf{0}, \mathbf{R}_h)$, $\mathbf{R}_h = \mathbf{U}\mathbf{\Lambda}\mathbf{U}^H$;
  Optimal channel estimation: Kalman filtering.
  Goal: Design $\mathbf{F}$ that supports a spatial matched filter Tx beamforming.
  Prop.: Use of dominant eigenvectors of Kalman prediction error cov. matrix as training signals minimize channel MSE.
- *Proposed scheme:* Channel estimate: Lin. comb. of all used training symbols - should be designed to capture n_d dominant channel eig. modes.
  Eigenvectors of $\mathbf{R}_h$ selected as the training signals.
  Min. and max. stead-state channel MSE derived - using Riccati equation.
  MMSE upper bound minimization; Max. steady-state channel MSE is reduced by transmitting the training signal more frequently.
  Hybrid analog-digital b/f: $\mathbf{R}_h \approx \tilde{\mathbf{F}}\mathbf{\Lambda}\tilde{\mathbf{F}}^H$; DFT-based training signal.
  Beamformer $\mathbf{F}$ will span subspace of training signal - matrix determined by distinct DFT columns.
- Extension to multiuser massive MIMO.

Permutation Trellis Coded Multi-Level FSK Signaling to Mitigate Primary User Interference in Cognitive Radio Networks. -R. El-Bardan, E. Masazade, O. Ozdemir, Y. S. Han, P. K. Varshney

- *Problem:* Inefficient usage of assigned frequency bands; performance degradation for SUs due to interference by PUs.

- *Contribution:* Use of PTC-based multi-level FSK signaling (no overhead); analytical BER and throughput; SU transmissions robust and resilient.

- *Model:* $x_k(t) = s_k^r(t) + \sum_j i_j^r(t) + w(t)$, $[i_j = 0 \text{ if PU is absent}]$.
  For each convolution coded o/p symbols, PTC encoder uses a code matrix. $\mathbf{T}_i$; H-FSK SUs transmit concurrently with PUs; interference from PUs independent for each SU bit.

- *BER analysis:* Through special properties of Viterbi decoder.
  Hamming distance b/w any two PTC matrices is lower-bounded by the Hamming distance b/w the convolution coded o/p symbols.
  $P_e \leq \sum_{d=d_{\text{free}}}^{\infty} a_d P(d) \approx \sum_{d=d_{\text{free}}}^{d_{\text{free}}+z} a_d P(d)$.

- *Throughput analysis:* Average throughput of the SU session in the presence of multiple PUs (activities are modeled as a 2- state Markov chain).
  SU Tx has no information regarding the presence or absence of PUs in the network.
  $T_e = (1 - PER) \times R_p \times L \approx (1 - \hat{P}_e)^L \times R_p \times L$.

Other interesting papers

- Omnidirectional Precoding Based Transmission in Massive MIMO Systems.
  - X. Meng, X. Gao, and X.-G. Xia
- Power Allocation for Distributed Antenna Systems in Frequency-Selective Fading Channels. - Q.-Y. Yu, Y.-T. Li, W. Xiang, W.-X. Meng, and W.-Y. Tang
- Adaptive Transmission Rate With a Fixed Threshold Decoder for Diffusion-Based Molecular Communication.
  - M. Movahednasab, M. Soleimanifar, A. Gohari, M. Nasiri-Kenari, and U. Mitra
- A Sparse Recovery Method for Initial Uplink Synchronization in OFDMA Systems.
  - M. M. Hyder and K. Mahata
- Full-Duplex Decode-and-Forward Relay-Assisted Interference Management: A Diversity Gain Region Perspective. - R. P. Sirigina and A. S. Madhukumar