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Joint adaptive power allocation and interference suppression algorithms based on the MSER criterion for wireless sensor networks

Key words: Cooperative communications, Adaptive filtering, Symbol error rate (SER), Interference suppression, Power allocation

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Contribution

- Based on the minimization of the SER cost function for WSNs with QPSK modulation, the theory estimation algorithm which jointly considers PA and interference suppression is proposed.
- Sample-by-sample based jointly adaptive implementations of the theoretical JMSER solution are developed on the basis of the kernel density estimate of the PDF.
- The analysis of convergence and computational complexity of the proposed adaptive algorithms is carried out.

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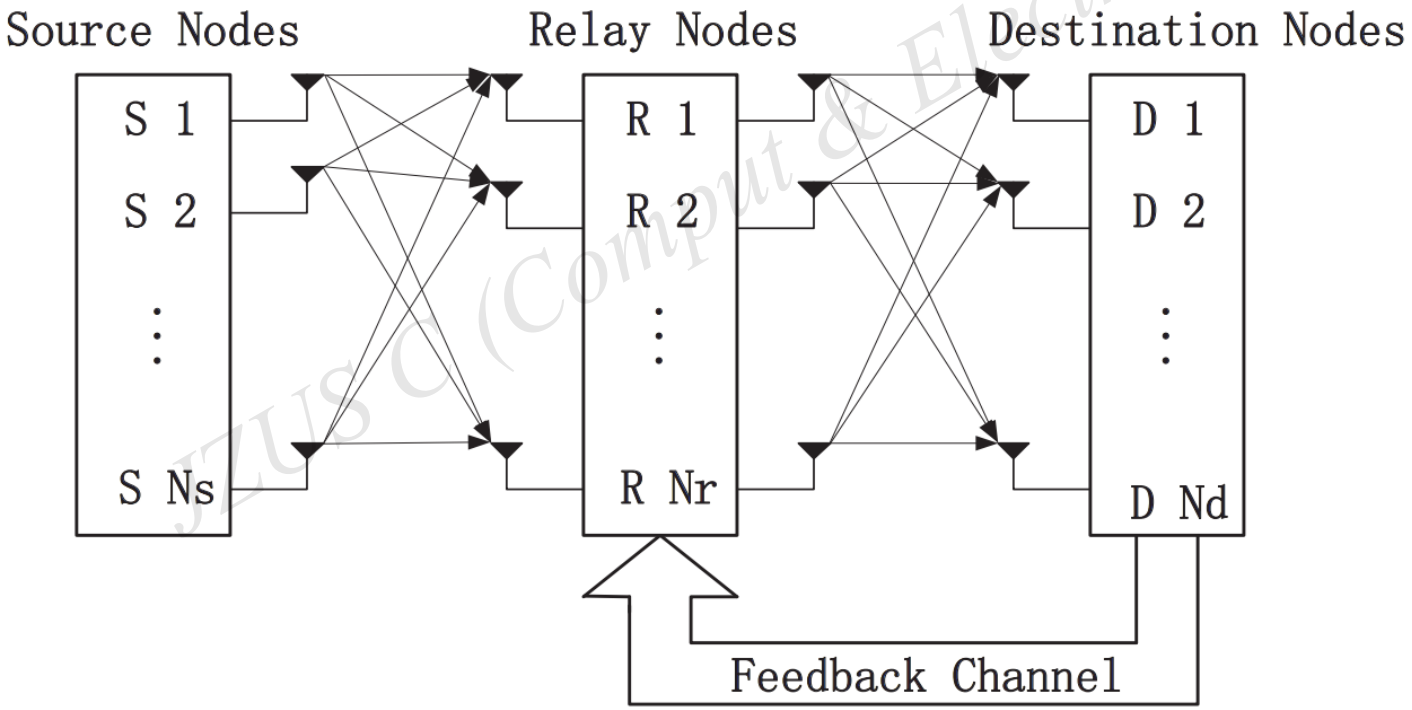
Design method (I)

System model



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Design method (II)

1. JMSER-SG algorithm

1: Initialize $\boldsymbol{w}_1, \boldsymbol{w}_2, \cdots, \boldsymbol{w}_{N_s}, \boldsymbol{a}$. Set $\mu_{\boldsymbol{w}_{JS}}$, $\mu_{\boldsymbol{a}_{JS}}$ and the number of cycles per symbol.
2: for each received symbol do
3: for each cycle do
4: for each source transmitted symbol, $k = 1, 2, \cdots, N_s$
5: update $\boldsymbol{w}_k$ using (22) and (24)
6: end source transmitted symbol
7: update $\boldsymbol{a}$ using (23) and (25)
8: end circle.
9: we obtain $\boldsymbol{w}_1, \boldsymbol{w}_2, \cdots, \boldsymbol{w}_{N_s}$ and $\boldsymbol{a}$ for the received symbol and move to the next symbols.

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Design method (III)

2. JMSER-CG algorithm

1: Initialize two step sizes $\mu_{\boldsymbol{w}_{JC}} > 0, \mu_{\boldsymbol{a}_{JC}} > 0$;
set the iteration index to $n = 1$. Given that $\boldsymbol{a}(1)$,
$\boldsymbol{w}_1(1), \cdots, \boldsymbol{w}_{N_s}(1)$, $\boldsymbol{c}_1(1) = -\nabla P_E(\boldsymbol{w}_1(1)), \cdots,$
$\boldsymbol{c}_{N_s}(1) = -\nabla P_E(\boldsymbol{w}_{N_s}(1))$, $\boldsymbol{g}(1) = -\nabla P_E(\boldsymbol{a}(1))$;

2: for $k = 1, \cdots, N_s$:

$$\boldsymbol{w}_k(n+1) = \boldsymbol{w}_k(n) + \mu_{\boldsymbol{w}_{JC}} \boldsymbol{c}_k(n)$$
$$\boldsymbol{w}_k(n+1) \leftarrow \frac{\boldsymbol{w}_k(n+1)}{\|\boldsymbol{w}_k(n+1)\|}$$
$$\phi_n^k = \frac{\|\nabla P_E(\boldsymbol{w}_k(n+1))\|}{\|\nabla P_E(\boldsymbol{w}_k(n))\|}$$
$$\boldsymbol{c}_k(n+1) = \phi_n^k \boldsymbol{c}_k(n) - \nabla P_E(\boldsymbol{w}_k(n+1))$$
$$k = k+1$$

3: After N_s iterations:

$$\boldsymbol{a}(n+1) = \boldsymbol{a}(n) + \mu_{\boldsymbol{a}_{JC}} \boldsymbol{g}(n)$$
$$\beta = \sqrt{\frac{P_r}{\|\boldsymbol{a}(n+1)\|^2}}$$
$$\boldsymbol{a}(n+1) \leftarrow \beta \boldsymbol{a}(n+1)$$
$$\varphi_n = \frac{\|\nabla P_E(\boldsymbol{a}(n+1))\|}{\|\nabla P_E(\boldsymbol{a}(n))\|}$$
$$\boldsymbol{g}(n+1) = \varphi_n \boldsymbol{g}(n) - \nabla P_E(\boldsymbol{a}(n+1))$$
$$n = n+1$$

We have detailed the computational complexity of the algorithms being analyzed:

Para	Algorithm	Multiplications	Additions
$\boldsymbol{w}_k$	JMSER-CG	$6N_sN_d + 1$	$5N_sN_d$
	JMSER-SG	$4N_sN_d + 1$	$4N_sN_d$
	MSER fixed	$4N_sN_d + 1$	$4N_sN_d$
	LMS fixed	$2N_sN_d + 1$	$2N_sN_d$
$\boldsymbol{a}$	JMSER-CG	$5N_sN_d + 1$	$5N_sN_d$
	JMSER-SG	$4N_sN_d + 1$	$4N_sN_d$

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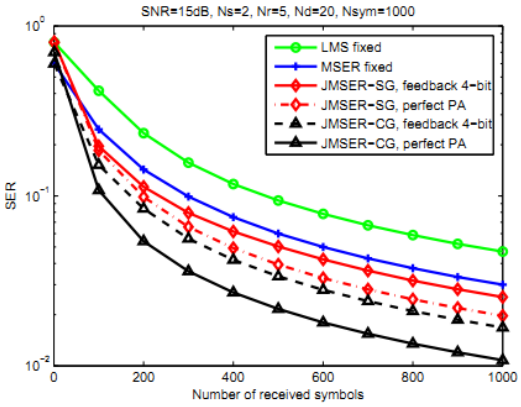
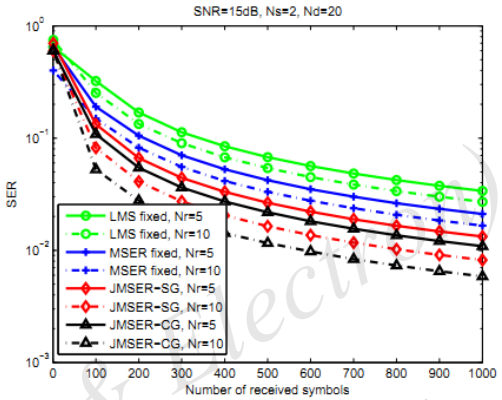
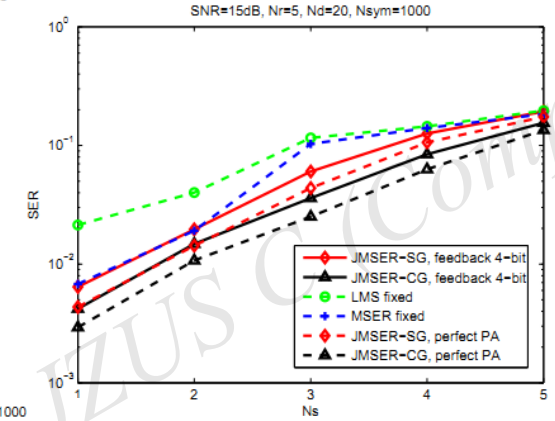
Simulation results





Feedback



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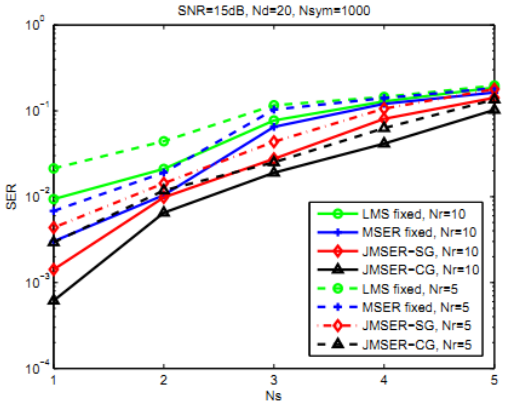

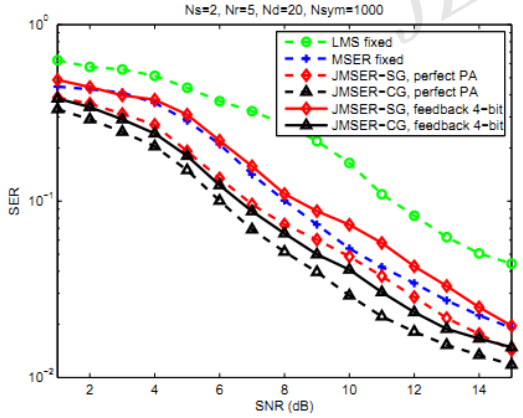

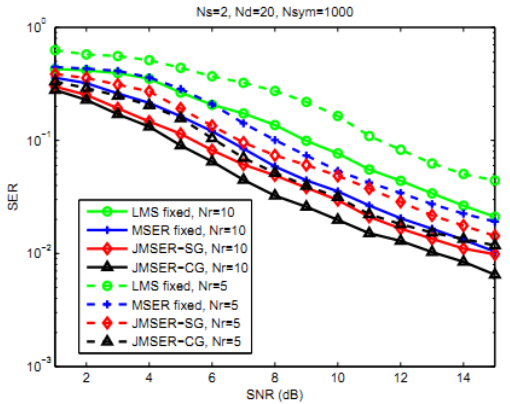

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