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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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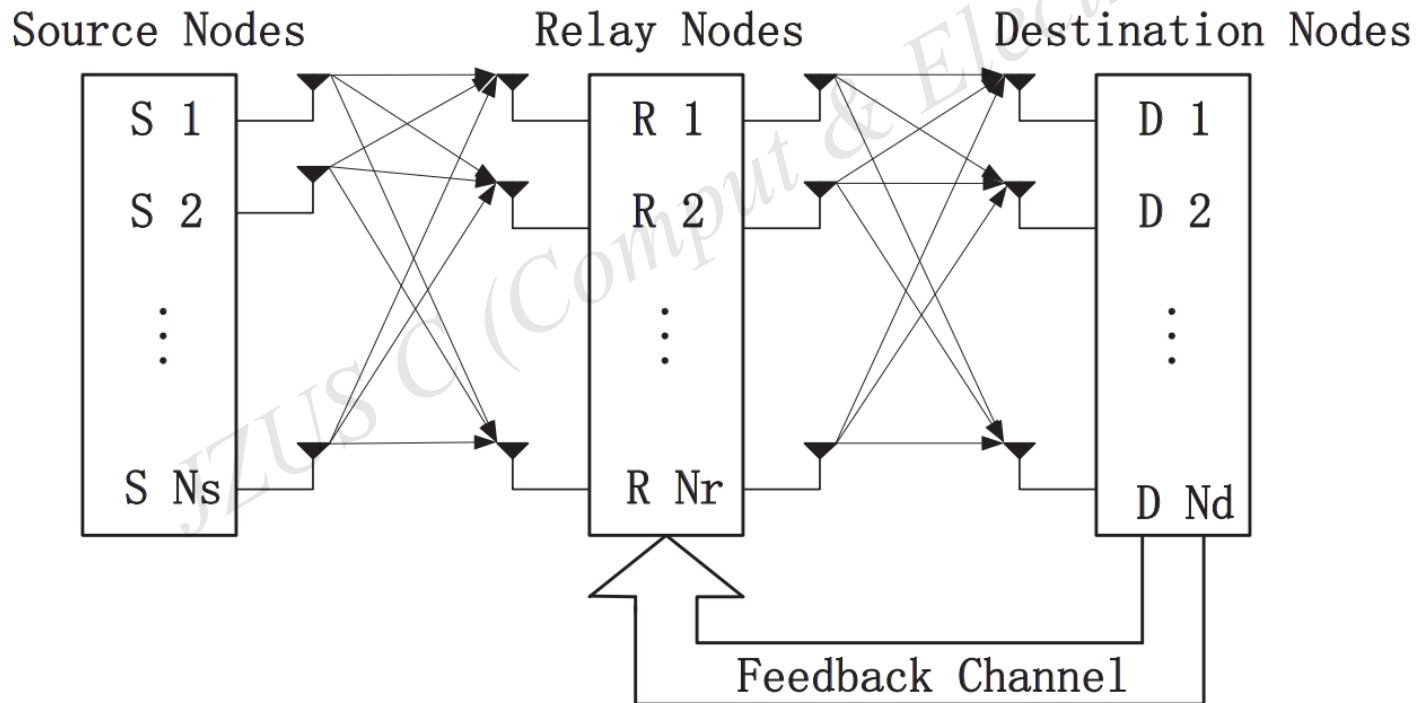
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# Contribution

- 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 JMSEER 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.

# Design method (I)

## System model



# Design method (II)

## 1. JMSE-SG algorithm

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- 1: Initialize  $w_1, w_2, \dots, w_{N_s}, a$ . Set  $\mu_{w_{JS}}$ ,  $\mu_{a_{JS}}$  and the number of cycles per symbol.
  - 2: for each received symbol do
  - 3:     for each cycle do
  - 4:         for each source transmitted symbol,  
            $k = 1, 2, \dots, N_s$
  - 5:             update  $w_k$  using (22) and (24)
  - 6:             end source transmitted symbol
  - 7:             update  $a$  using (23) and (25)
  - 8:     end circle.
  - 9: we obtain  $w_1, w_2, \dots, w_{N_s}$  and  $a$  for the received symbol and move to the next symbols.
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# Design method (III)

## 2. JMSE-CG algorithm

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

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

$$\mathbf{w}_k(n+1) = \mathbf{w}_k(n) + \mu_{\mathbf{w}_{JC}} \mathbf{c}_k(n)$$

$$\mathbf{w}_k(n+1) \leftarrow \frac{\mathbf{w}_k(n+1)}{\|\mathbf{w}_k(n+1)\|}$$

$$\phi_n^k = \frac{\|\nabla P_E(\mathbf{w}_k(n+1))\|}{\|\nabla P_E(\mathbf{w}_k(n))\|}$$

$$\mathbf{c}_k(n+1) = \phi_n^k \mathbf{c}_k(n) - \nabla P_E(\mathbf{w}_k(n+1))$$

$$k = k + 1$$

3: After  $N_s$  iterations:

$$\mathbf{a}(n+1) = \mathbf{a}(n) + \mu_{\mathbf{a}_{JC}} \mathbf{g}(n)$$

$$\beta = \sqrt{\frac{P_r}{\|\mathbf{a}(n+1)\|^2}}$$

$$\mathbf{a}(n+1) \leftarrow \beta \mathbf{a}(n+1)$$

$$\varphi_n = \frac{\|\nabla P_E(\mathbf{a}(n+1))\|}{\|\nabla P_E(\mathbf{a}(n))\|}$$

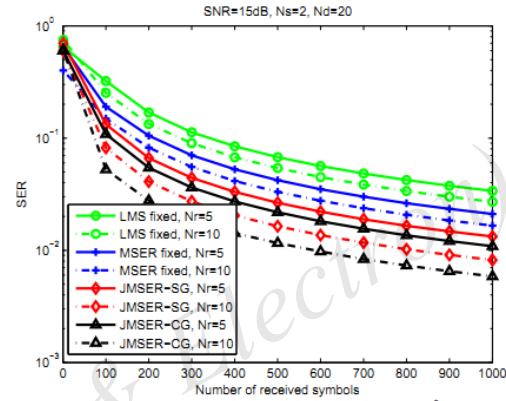
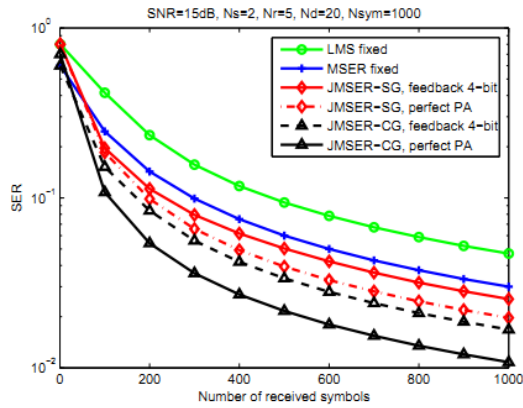
$$\mathbf{g}(n+1) = \varphi_n \mathbf{g}(n) - \nabla P_E(\mathbf{a}(n+1))$$

$$n = n + 1$$

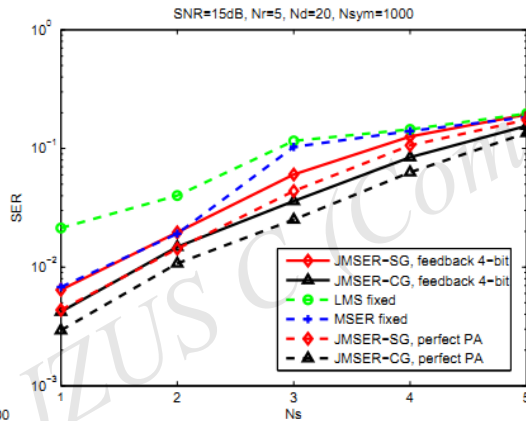
We have detailed the computational complexity of the algorithms being analyzed:

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

# Simulation results



Feedback



No feedback

