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► **To cite this version:**

Xiao Yang, Yide Wang, Pascal Chargé. An Ambiguity-Solving Method for DOA Estimation with Unfolded Co-prime Arrays. Fifth Sino-French Workshop on Information and Communication Technologies (SIFWICT 2019), Jun 2019, Nantes, France. hal-02167974

HAL Id: hal-02167974

<https://hal.science/hal-02167974>

Submitted on 3 Jul 2019

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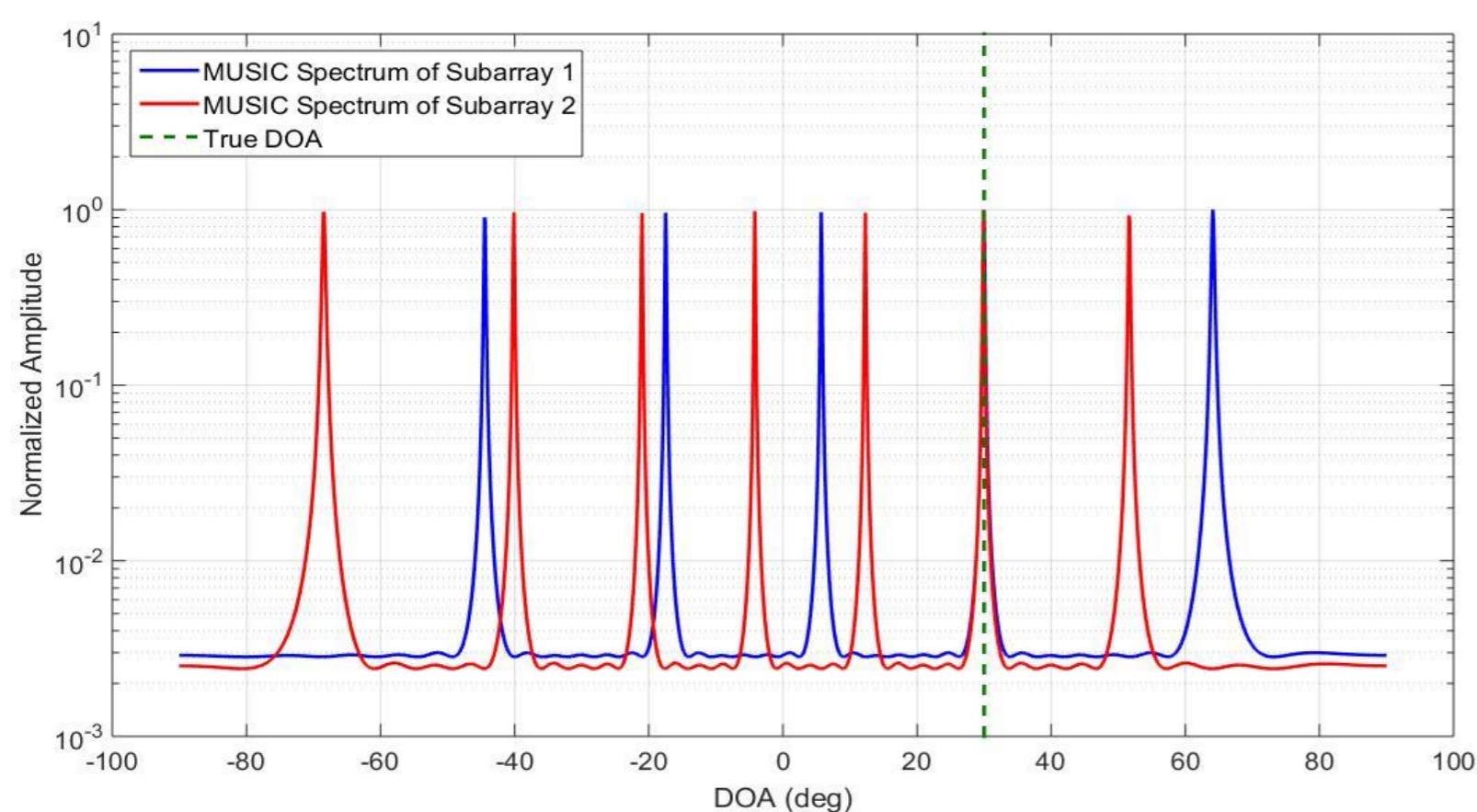
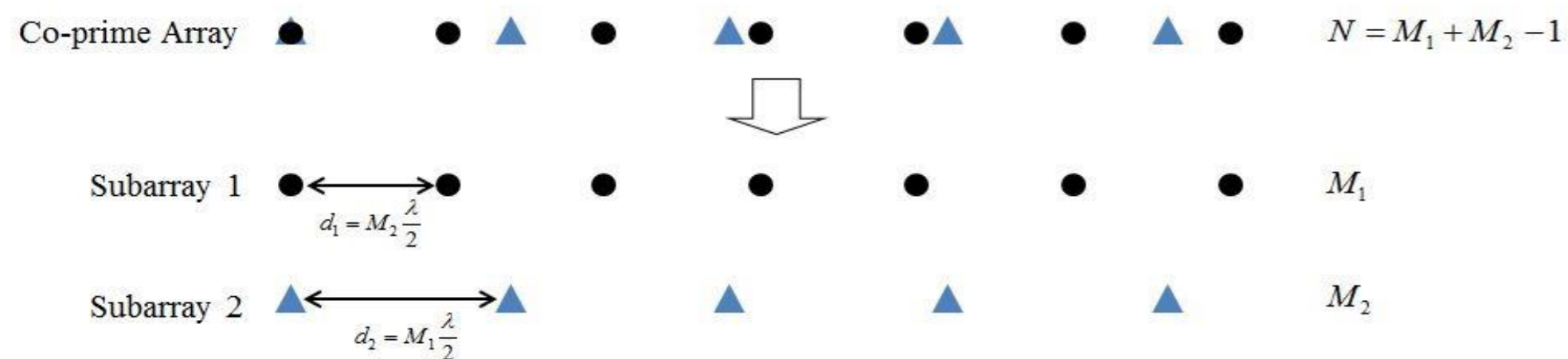
An Ambiguity-Solving Method for DOA Estimation with Unfolded Co-prime Arrays

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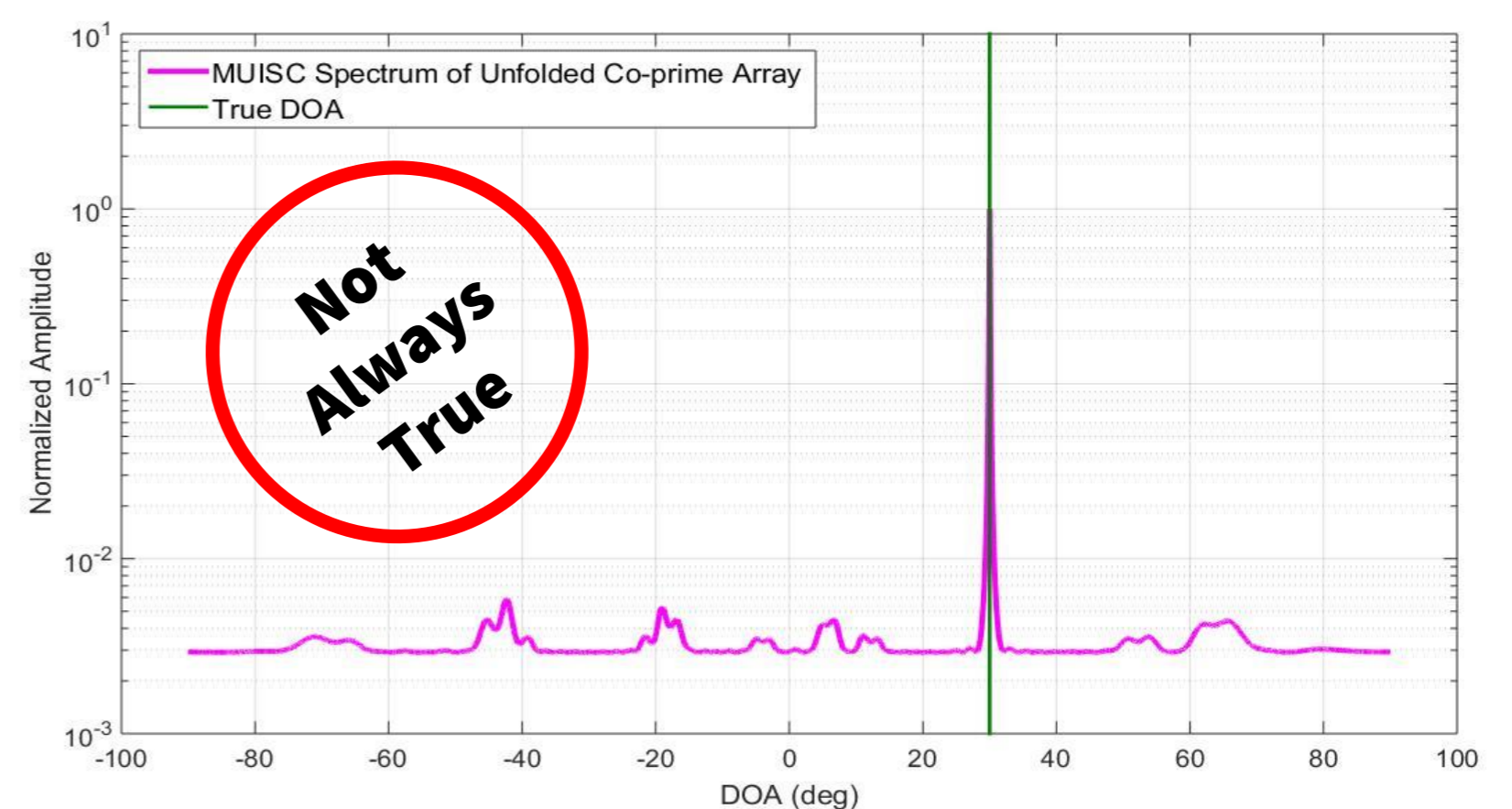
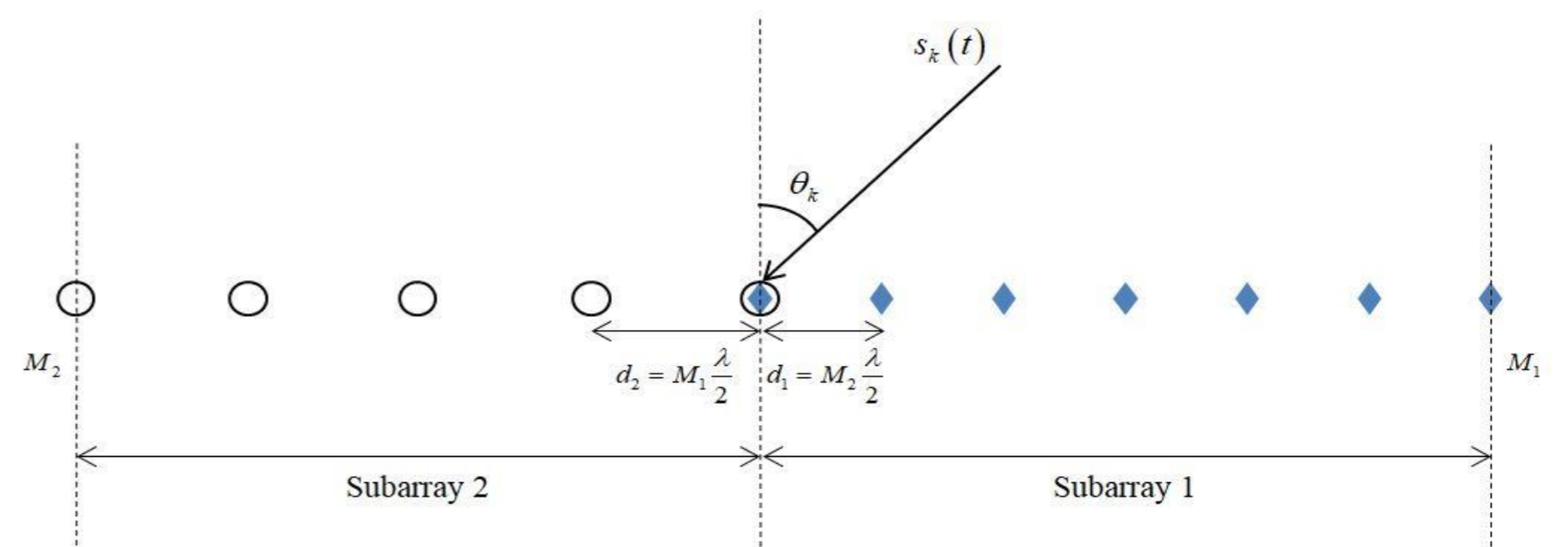
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General Co-prime Linear Array



Unfolded Co-prime Linear Array



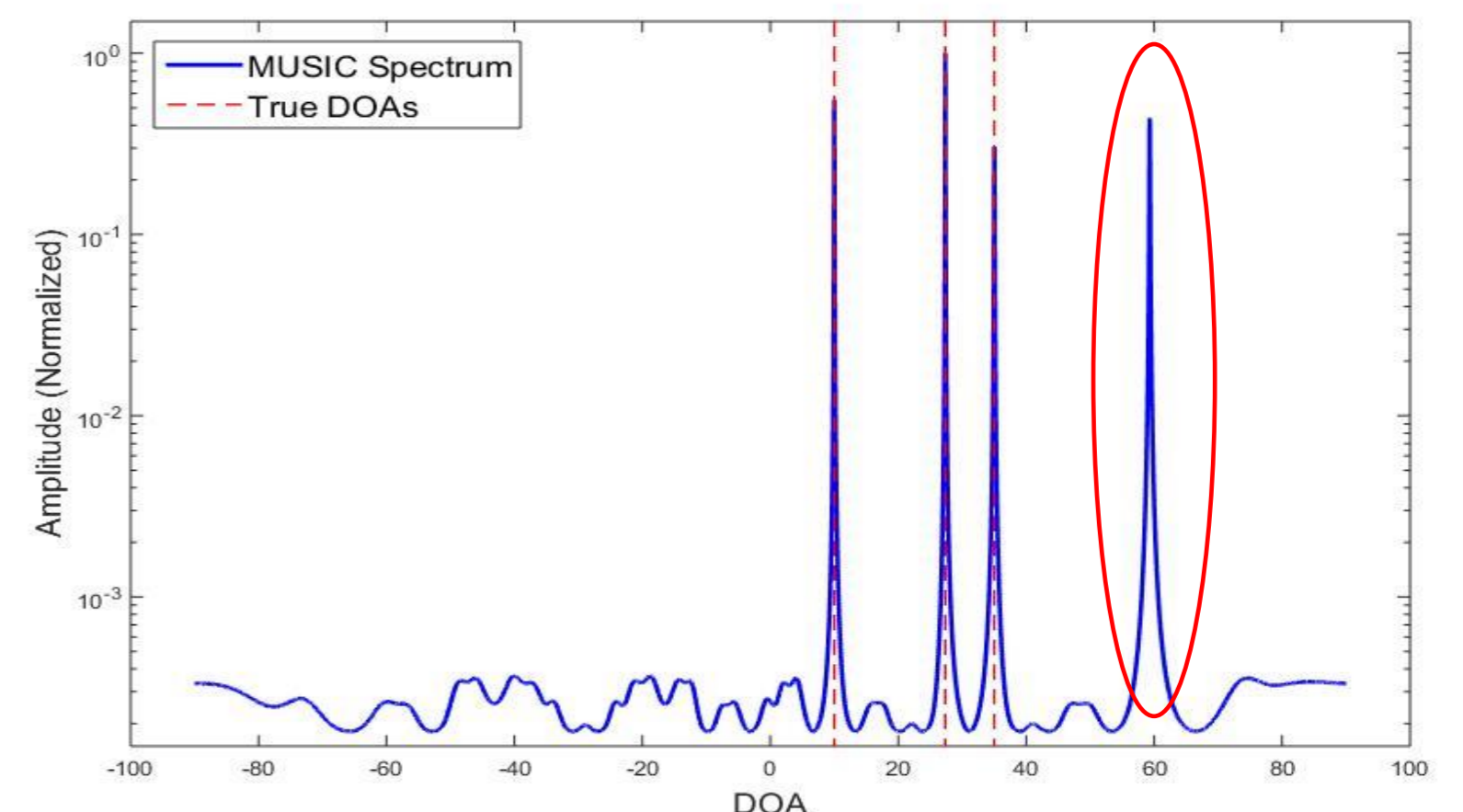
Ambiguity Problem for Unfolded Co-prime Linear Arrays

Consider there are four signals coming from $\theta_1, \theta_2, \theta_3$ and θ_4 , satisfying

$$\begin{cases} \sin\theta_1 = \sin\theta_2 + \frac{2a}{M_1} \\ \sin\theta_1 = \sin\theta_3 + \frac{2b}{M_2} \\ \sin\theta_4 = \sin\theta_2 + \frac{2c}{M_2} \\ \sin\theta_4 = \sin\theta_3 + \frac{2d}{M_1} \end{cases} \Rightarrow \begin{cases} \mathbf{a}_1(\theta_1) = \mathbf{a}_1(\theta_3) \\ \mathbf{a}_2(\theta_1) = \mathbf{a}_2(\theta_2) \\ \mathbf{a}_1(\theta_4) = \mathbf{a}_1(\theta_2) \\ \mathbf{a}_2(\theta_4) = \mathbf{a}_2(\theta_3) \end{cases}$$

$$\mathbf{a}(\theta_1) - \mathbf{a}(\theta_2) - \mathbf{a}(\theta_3) + \mathbf{a}(\theta_4) = \mathbf{0}$$

The directional vector of each one of the four angles can be represented as a linear combination of the directional vectors of the other three, lying in the signal subspace and being orthogonal to the noise subspace, resulting in an ambiguity in the MUSIC spectrum.



Ambiguity-Solving Method

candidate angles: $\hat{\theta}_1 \quad \hat{\theta}_2 \quad \hat{\theta}_3 \quad \hat{\theta}_4$

directional vectors: $\mathbf{a}(\hat{\theta}_1) \quad \mathbf{a}(\hat{\theta}_2) \quad \mathbf{a}(\hat{\theta}_3) \quad \mathbf{a}(\hat{\theta}_4)$

Classical Beamforming powers:

$$P_{CBF,q} = \frac{\mathbf{a}^H(\hat{\theta}_q) \mathbf{R} \mathbf{a}(\hat{\theta}_q)}{N^2}$$

$\hat{\theta}_q$	$\hat{\theta}_1$	$\hat{\theta}_2$	$\hat{\theta}_3$	$\hat{\theta}_4$
$P_{CBF,q}$	big	big	big	small
True or Ambiguous	true	true	true	ambiguous

