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• Supplementary File •

Eigenvalue-based distributed target detection in compound-Gaussian clutter

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1 More information

In this appendix, the evaluation of the detection performance of the detectors proposed in this letter under more parameter settings is presented to reflect the effectiveness of the proposed methods in a more comprehensive manner.

Figure A1 shows the variations of the PFAs of the detectors proposed in this letter and the MGM-D-nW proposed in [3] under different clutter correlation characteristics (i.e., one-lag correlation coefficients). It can be seen from the figure that the PFAs of the proposed detectors in this letter do not change with the variations of the clutter correlation characteristics, while for the MGM-D-nW, its PFA increases as the clutter correlation parameters increase. The reason is that the detectors proposed in this letter contain a data whitening process, which realizes clutter suppression and thus enables the detectors to have the constant false alarm rate (CFAR) characteristic.

The detection performance of adaptive detectors with clutter suppression capabilities is affected by the output signal-to-clutter ratio (SCR) [1]. The detectors proposed in this letter also belongs to the category of adaptive detectors and has clutter suppression capabilities. The essence of the superior detection performance of the proposed detectors for highly correlated clutter is that the proposed detectors can improve the output SCR. This factor is confirmed in Figure A2, which shows the input and output SCRs under different one-lag correlation coefficients. The input and output SCRs are defined as

$$\mathrm{SCR}_{\mathrm{in}} = \frac{1}{N}\frac{\sum_{l=1}^{K}|\beta_l|^2\mathbf{p}^H\mathbf{p}}{\mathrm{tr}(\mathbf{R})} \tag{1}$$

and

$$\mathrm{SCR}_{\mathrm{out}}=\frac{1}{N}\sum_{l=1}^{K}|\beta_l|^2\mathbf{p}^H\mathbf{R}^{-1}\mathbf{p}, \tag{2}$$

respectively. The results in Figure A2 show that the output SCR is significantly higher than the input SCR, especially when the clutter correlation characteristics are relatively strong. In other words, the proposed detectors can suppress the clutter quite effectively for highly correlated clutter, thus improving the detection performance.

Figure A3 presents the PDs of the detectors proposed in this letter and the detector MGM-D-nW in [3] under different PFAs. This type of figure is usually called the receiver operating characteristic (ROC) curve. It can be seen from the figure that the PDs of the detectors proposed in this letter are

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obviously higher than that of the MGM-D-nW. This is because the proposed detectors have the function of clutter suppression, which realizes the improvement of the target detection performance in the clutter environment.

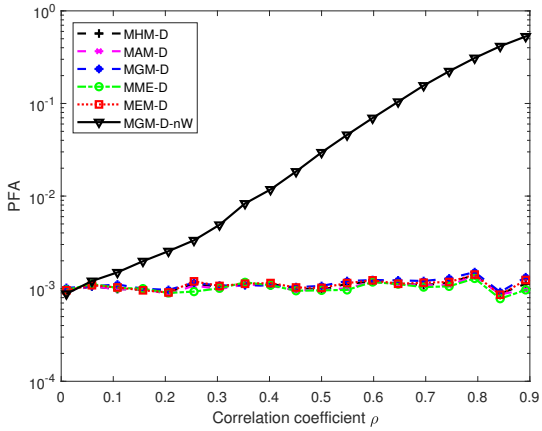

Figure A1 The PFAs of the detectors under different clutter correlation characteristics. $N = 8$, $K = 4$, $L = 16$, $\nu = 0.9$, $\mu = 1.3$, and $f_d = 0.05$.

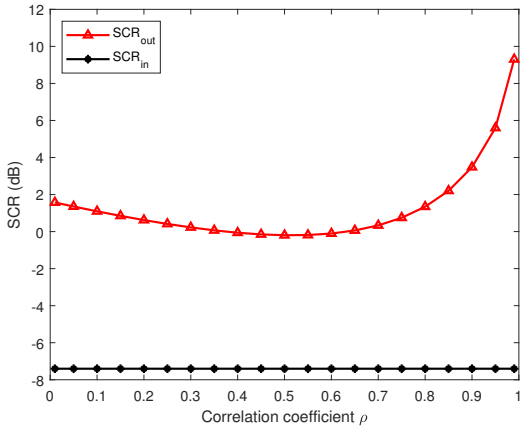

Figure A2 The input and output SCRs. $N = 8$, $K = 4$, $\beta_k = 2$, $k = 1, ..., K$, and $f_d = 0.05$.

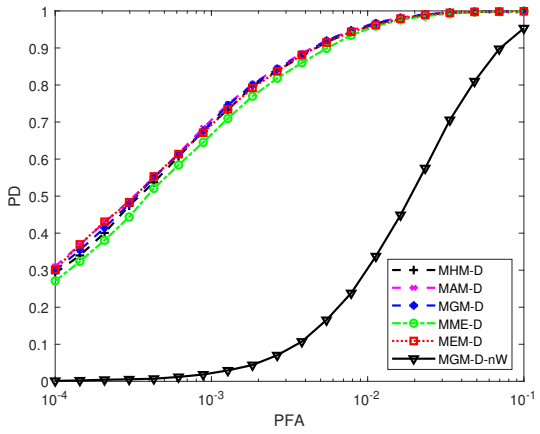

Figure A3 The ROC curves of the detectors. $N = 8$, $K = 4$, $\rho = 0.9$, $L = 16$, $\nu = 0.9$, $\mu = 1.3$, $\mathrm{SCR_{out}} = 12\mathrm{dB}$, and $f_d = 0.05$.