

Application of Beamforming based on Covariance Matrix Weighting

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Abstract: In this paper, Covariance Matrix Weighting beamforming (CMW) method is developed. It is a method which significantly ($>9\text{dB}$) improve performance gains using correlation character of measured noise data. The method contains CMW, peak-pick and bearing-time record (BTR) methods. CMW method is developed from Inverse Beamforming (IBF) method. It overcomes IBF's limit of using for linear array in measured ocean data and real-time at-sea experiments, could be applied to arbitrary arrays. It is also able to improve performance gain more than 3dB limit of IBF. The rest performance gains are realized by peak-pick and BTR methods. CMW method directly weights the elements of the spatial correlations matrix, restrains the ANG by reducing the ratio of the noise relative element and increasing the ratio of the signal relative element in the correlation matrix. The values of weighting matrix elements depend on the distribution of the array elements. The mainly work of this method is to design optional weighting matrix. Three methods getting weighting matrix are given in this paper. And they are used for different arrays and different ambient noise field. Conclusion is that using CMW method in correlation noise condition can get much better performance than it in ideal condition. That is to say, applying CMW to real-time experiment, CMW can get better performance than 9dB . In forth section of this paper, CMW is compared with MVDR. Stability advantage to vary of ambient noise field and errors of the array position of CMW are testified. In the final part of this paper, all advantages of CMW method are testified by simulation and measured ocean data.