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PERFORMANCE ANALYSIS AND ROBUST DESIGN ON GNSS ANTI-JAMMING ANTENNAS IN THE WORST-CASE SIGNAL BASED ON COMPLEX ELECTROMAGNETIC ENVIRONMENT

Abstract

Complex electromagnetic environment refers to in a certain geographical space, the environment consists of the electromagnetic signals distributed in the spatial, time domain, frequency domain, and energy, which should show as volume, overlapping, intensive, dynamic overlap, and so on. GNSS are facing these complex electromagnetic environments, so as to reply the “navigation combat” for striving for the control power of the navigation resource, the analysis of GNSS anti-jamming antennas in the worst-case signal based on complex electromagnetic environment and the robust algorithm design for these environments should be crucial important.

For the common DBF (Digital Beam Forming) anti-jamming algorithm, the direction vector of signals will be easy to appear “deviation” owing to the environmental effect, thereby, the assumed response of the antenna array will be mismatching with the actual response of the antenna array. DBF algorithm is extremely sensitive to these “deviation”, it will take the desired signal as interference and suppression it by forming “zero trap” in the direction of arrival of the signal, which will result in the performance of the array output “sharp decline”. Furthermore, in some certain DBF algorithm, when the incident wave was consist of not only constant envelope desired signal, but also multiple constant envelope interference signals, if the selection of the initial weighted vectors of iteration is unsuitable, the output of the beam forming will not be able to approximate to the desired signal, in other word, there are interference capture phenomenon existed.

Consider those above problems, take the Y-shaped-array as an example to conduct experimental verification. For the ideal signal and the worst-case signal, the directional diagram of the arraythe SINR of output signal and the performance of different SNR will be compared and analysis carefully. Then the direction vector of signals will be limited in a certain uncertainty set by utilizing the worst-case performance optimization method, and structure a cost function with linear constraints conditional, express the robust beam forming as a convex quadratic programming, proceed to the next step, to solve the optimal weighted vectors, so as to improve the SINR performance of the system output, and it should provide some reference for the navigation countermeasures under the worst-case signal based on the complex electromagnetic environment.