known in advance; new terms can be added until the mean-square error is satisfactorily reduced. The method is orthogonal in that the values of the coefficients $c_{n,n}$ do not have to be recalculated if further terms are introduced in the representation.

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References


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CANCELLATION PERFORMANCE DEGRADATION OF A FULLY ADAPTIVE YAGI ARRAY DUE TO INNER-ELEMENT COUPLING

Indexing terms: Antennas, Adaptive arrays

The effect of inner-element coupling on the cancellation performance of a fully adaptive Yagi array is considered. Graphs of the output residue power as functions of interference-to-noise ratio and bandwidth with and without the inner-coupling effect are presented. It is seen that mutual coupling, like any other frequency-dependent error source, poses a severe limitation to the ability of the array to counteract sidelobe interference.

In adaptive arrays of complicated structures such as the 15-element Yagi array shown in Fig. 1, the elements possess frequency-dependent characteristics due to mutual coupling. This frequency dependence is of primary importance because, like any other frequency-dependent error source, it can limit the amount of achievable cancellation performance. This letter quantitatively addresses the fundamental effect of the above-mentioned phenomenon on the ability of the fully adaptive Yagi array to counteract sidelobe interference.

An analysis of the array that takes all mutual coupling effects into account is feasible via the method of moments. It is assumed that all dipoles are perfectly conducting, electrically thin cylinders. Accordingly, the currents are replaced by filaments of current on the axis of each cylinder. Subsequently, each filament is subdivided into small subsections. The boundary condition to be satisfied is that the tangential electric field is zero on the surface of each dipole, except at the narrow gap where a voltage source is applied. Imposition of the boundary condition in a Galerkin solution reveals the unknown filamentary currents. These currents are then applied to derive the far fields.

Fig. 2 shows plots of element gain at various angles as a function of frequency when the centre element is excited while the other elements are terminated with 50Ω. Cases shown are $\theta = 0^\circ$, $\theta = -15^\circ$, $\theta = -30^\circ$, $\theta = -45^\circ$, $\theta = 60^\circ$ and $\theta = -75^\circ$, where $\theta$ is measured in the $x$-$z$-plane relative to the $z$ axis. Similar, but nevertheless different, curves (not shown) were obtained when frequency responses of the other elements were examined. Apparently, the element-gain frequency response depends on both the spatial angle $\theta$ and the location of the element in the array.

![Fig. 2: Centre element frequency response](image_url)

**Fig. 2** Centre element frequency response

15 elements

![Fig. 3: Output residue power against interference-to-noise ratio](image_url)

**Fig. 3** Output residue power against interference-to-noise ratio

- a: Uncancelled residue
- b: Cancelled residue with Yagi frequency slopes; normal distribution: $\sigma = 0.13\, \text{dB/MHz}$, $\mu = 0.0\, \text{dB/MHz}$
- c: Cancelled residue; no Yagi frequency slopes

15 elements

Fully adaptive

Bandwidth = 3 MHz

Ten interference sources

![Fig. 4: Output residue power against bandwidth](image_url)

**Fig. 4** Output residue power against bandwidth

- a: Cancelled residue with Yagi frequency slopes; normal distribution: $\sigma = 0.13\, \text{dB/MHz}$, $\mu = 0.0\, \text{dB/MHz}$
- b: Cancelled residue; no Yagi frequency slopes

15 elements

Fully adaptive

Ten interference sources

$I/N = -70\, \text{dB}$