FM/HD Radio Interleaved Antennas

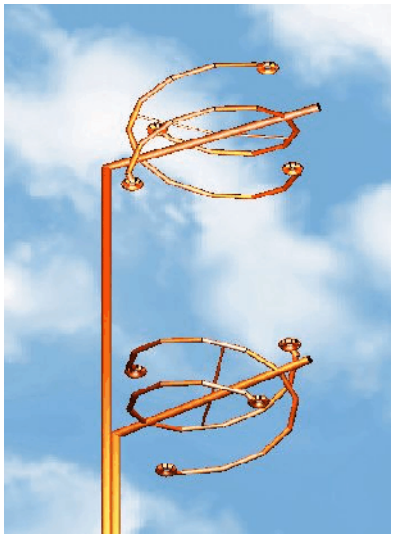
Richard J. Fry, CPBE

A commonly proposed method for combining the analog and digital components of FM-HD radio is by the use of “space combining.” This implementation radiates the analog and digital signals separately using two antennas installed at different locations–with both antennas usually on the same supporting structure. The risk in this approach is that the azimuth and elevation patterns of the separate antennas may not overlay each other well, which can cause the ratio of analog to digital energy at some receive locations to depart from the required 20dB value, and perhaps substantially, as shown in a recent NAB study.

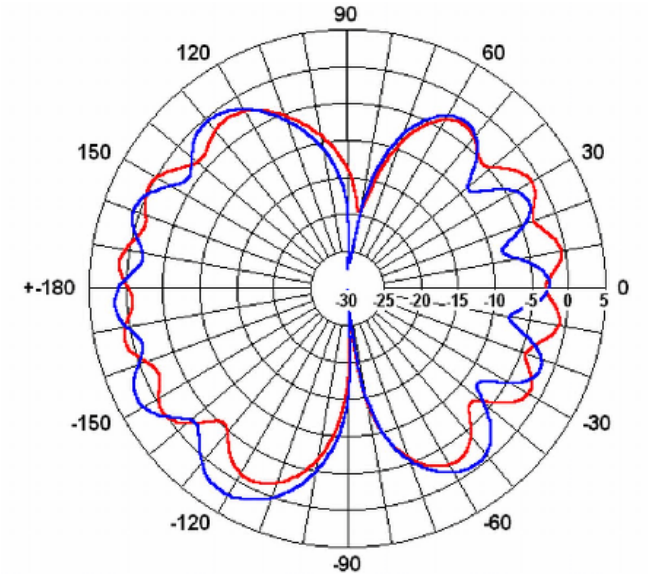
Recently it has been proposed by some suppliers that radiation patterns from the separate antennas will be “the same” if a cross-polarized HD antenna is interleaved in the same aperture as the analog antenna. But evaluation of this approach in a pristine configuration shows a fair amount of asymmetry between the two patterns, especially for vertical polarization. The patterns below were generated using Numerical Electromagnetics Code (NEC-2) for the interleaved antennas and conditions shown, and illustrate this effect.

NEC-2 Radiation Patterns of Interleaved Antenna Elements and Adjacent Transmission Lines (proposed for HD Radio)

* Elevation Patterns at Zero-180 Degree Azimuth Bearing
* LH & RH CP Elements at ½-wave Vertical Spacing



Transmission lines extend to a point 25 feet below the bottom bay.



V-Pol, Upper Bay (only) Driven
V-pol, Lower Bay (only) Driven

(continued…)

These pattern differences could be accentuated by differences in tower geometry near each bay. Such differences are likely unless the interleaved arrays are mounted on an aperture of electrically uniform construction, such as an untapered pole.

The NAB study showed fairly large variations in received A-to-D ratio even when a single transmit antenna was used for A&D. Adding the pattern differences likely when separate antennas are used could produce additional variation—even if they are interleaved.

Cross-polarizing the A&D transmit antennas when interleaved should reduce the coupling and interaction between the analog and digital transmitters, however the radiation patterns of the interleaved antennas may not match each other as well as first expected.

December 2003

Richard Fry is an RF systems analyst and retired FM Applications Engineer.
Email: rfry@adams.net