Erratum: Highly subwavelength, superdirective cylindrical nanoantenna [Phys. Rev. Lett. 120, 237401, (2018)]

Samel Arslanagić and Richard W. Ziolkowski

Due to an unfortunate MatLab syntax error, the numerically optimized results report in [1] were incorrect. The authors thank Dr. Wan Chen, Harbin Institute of Technology, for his interest in our work and for questioning the original results. Revisiting the numerical optimization code, the following results were obtained and confirmed independently for the five-layer cylinder having an outer radius $r_5 = \lambda_0/10$ and being excited by a magnetic line source (MLS) located along the $\phi = 180^\circ$ direction at the distance $1.05\, r_5$ from the center axis of the structure. The inner radii of the layers are specified to be $r_1 = 0.01\ \lambda_0, r_2 = 0.03\ \lambda_0, r_3 = 0.06\ \lambda_0$, and $r_4 = 0.08\ \lambda_0$. The relative permittivities in this five-layer structure are: $\varepsilon_{1r} = 5.00, \varepsilon_{2r} = 0.15285, \varepsilon_{3r} = -2.02885, \varepsilon_{4r} = 7.4653$, and $\varepsilon_{5r} = -8.40$. The exterior region is free-space with a relative permittivity equal to 1.0. The corresponding $m = 0, 1, \ldots, 5$ scattering coefficients were obtained and used to calculate the directivity.

The maximum directivity $D_{\mathrm{N=5,max}} = 6.37 = 8.04$ dB occurs along the $\phi = 0^\circ$ direction and the associated FTBR $= 10.03 = 10.01$ dB. This maximum is $5.07\, D_{\mathrm{2D}}$, i.e., 5.07 times the directivity of the analogous uniformly excited two-dimensional antenna system. The corresponding contour and field distribution plots of the total magnetic field are provided in [2]. A comparison of the directivity determined with this numerically optimized structure and those obtained for the corresponding analytical Dirac-delta based scattering coefficients is also given. Many similar outcomes have been found with the optimization process. While some yield larger directivity values, they typically exhibit lower FTBR values. These results adequately demonstrate that the conclusions in the Letter for the multilayered cylinder are not affected by the coding error, i.e., it acts as a superdirective lens element that transduces the cylindrical waves from the MLS into a highly directive beam.

[1] S. Arslanagić and R. W. Ziolkowski Phys. Rev. Lett. **120**, 237401 (2018).

[2] See Supplemental Material at http://link.aps.org/ supplemental/10.xxxx/physrevlett.yyy.zzzzzz .

Supplementary On-line Material
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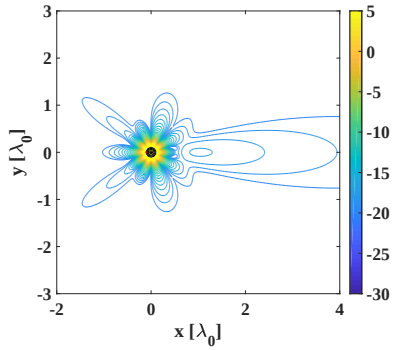
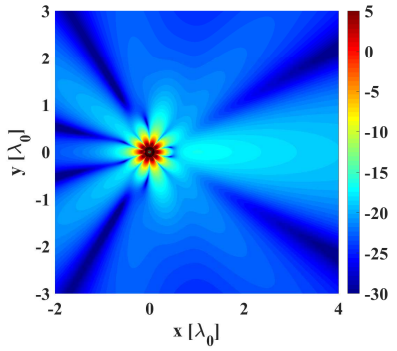
The numerical results for the five-layer cylinder having an outer radius $r_5 = \lambda_0/10$ and being excited by a magnetic line source (MLS) located along the $\phi = 180°$ direction at the distance $1.05\, r_5$ from the center axis of the structure are presented here. The inner radii of the layers are specified to be $r_1 = 0.01\ \lambda_0, r_2 = 0.03\ \lambda_0, r_3 = 0.06\ \lambda_0$, and $r_4 = 0.08\ \lambda_0$. The relative permittivities in this five-layer structure are: $\varepsilon_{1r} = 5.00, \varepsilon_{2r} = 0.15285, \varepsilon_{3r} = -2.02885, \varepsilon_{4r} = 7.4653$, and $\varepsilon_{5r} = -8.40$. The exterior region is free-space with a relative permittivity equal to 1.0. The corresponding $m = 0, 1, \ldots, 5$ scattering coefficients were obtained and used to calculate the directivity.



(a)



(b)

FIG. 1. Plots of $10 \log_{10} |H_z(x, y)|$ for the MLS-excited, 5-layer highly subwavelength cylinder. (a) Field contours (red dot denotes the source location). (b) Field distribution - analytical.

Contour and distribution plots of the magnitude of the total magnetic field: $10 \log_{10} |H_z^{\rm tot}(x, y)|$ (i.e., in dB units), of the optimized 5-layer structure are shown in Figs. 1(a) and 1(b), respectively. As shown in Fig. 2, these results were confirmed independently with a COMSOL Multiphysics simulation. A comparison of the directivity determined with the numerically obtained scattering coefficients and the analytical Dirac-delta based ones for this MLS-excited 5-layer cylindrical scattering structure is given in Fig. 3. The maximum directivity $D_{\rm N=5,max} = 6.37 = 8.04$ dB occurs along the $\phi = 0°$ direction and the associated FTBR $= 10.03 = 10.01$ dB. This maximum is $5.07\, D_{\rm 2D}$, i.e., 5.07 times the directivity of the analogous uniformly excited two-dimensional antenna system. As

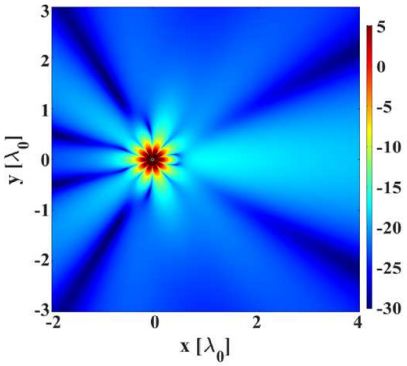


FIG. 2. Plot of $10 \log_{10} |H_z(x, y)|$ for the MLS-excited, 5-layer highly subwavelength cylinder calculated with COMSOL Multiphysics.

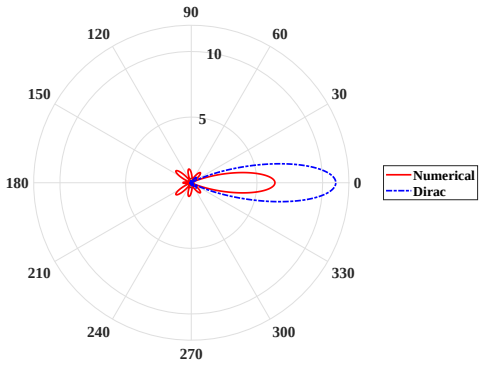


FIG. 3. Comparisons of the directivity obtained with only the $m = 0, 1, \ldots, 5$ numerically obtained and the Dirac-delta based scattering coefficients for the MLS-excited, 5-layer highly subwavelength cylinder. (Linear scale)

reported originally, these results demonstrate that this multilayered cylinder acts as a superdirective lens element that transduces the cylindrical waves from the MLS into a highly directive beam.