Communications

Corrections to "On Optimal Shading for Arrays of Irregularly-Spaced or Noncoplanar Elements"

Timothy C. Gallaudet and Christian P. de Moustier

In the above paper,[1] due to an editing oversight, Fig. 5 and its caption were printed in place of Fig. 4. In addition, the caption for Table I was left out.

Manuscript received July 19, 2001.

The authors are with the Marine Physical Laboratory, Scripps Institution of Oceanography, University of California at San Diego, La Jolla, CA 92093 USA.

Publisher Item Identifier S 0364-9059(01)08541-7.

[1] T. C. Gaullaudet and C. P. de Moustier, *IEEE J. Oceanic Eng.*, vol. 25, no. 4, pp. 553–567, Oct. 2000.

However, the array factors displayed in Figs. 9–11 were plotted incorrectly. New figures are presented here for the array factor, which is computed for a $M \times N$ element planar array as

$$f(\theta, \phi) = \sum_{n=1}^{M \times N} \exp\left(-i\frac{2\pi}{\lambda}[x_n \sin\theta\cos\phi + y_n \sin\theta\sin\phi]\right) \quad (1)$$

where

- λ acoustic wavelength;
- θ elevation angle;
- ϕ azimuthal angle;
- x_n, y_n horizontal distances of the nth element from the phase center of the array.

Table I has been updated with these corrections which show that the main lobe width and gain with respect to the sidelobes vary little over the full range of ϕ, and do not change the discussion or conclusions in the original text.

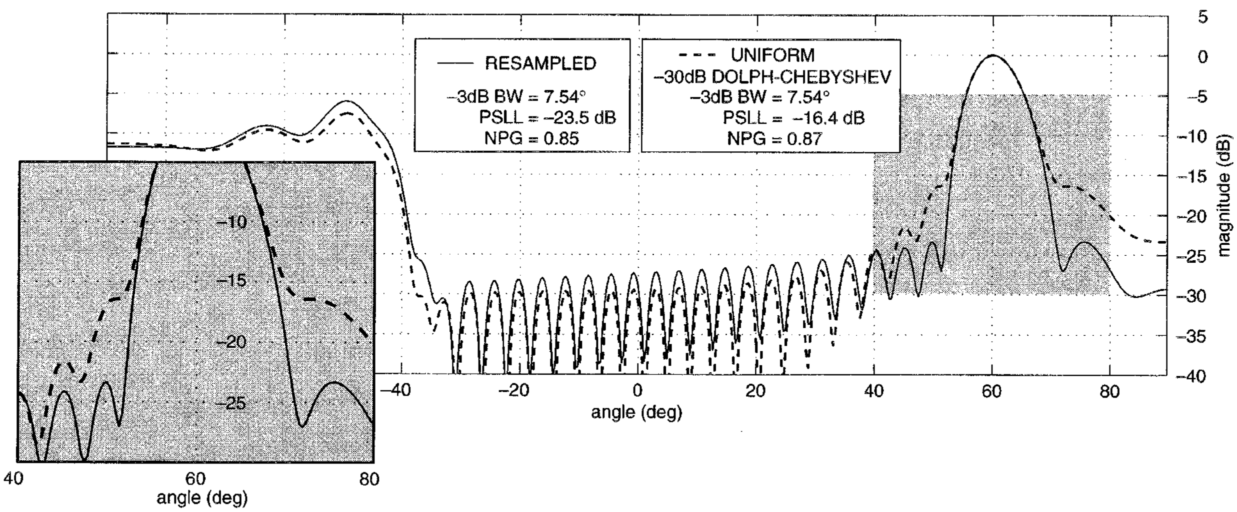

Fig. 4. Resampled amplitude shading for an irregular-line array: same as Fig. 3 with beam steered to $\theta = 60°$.

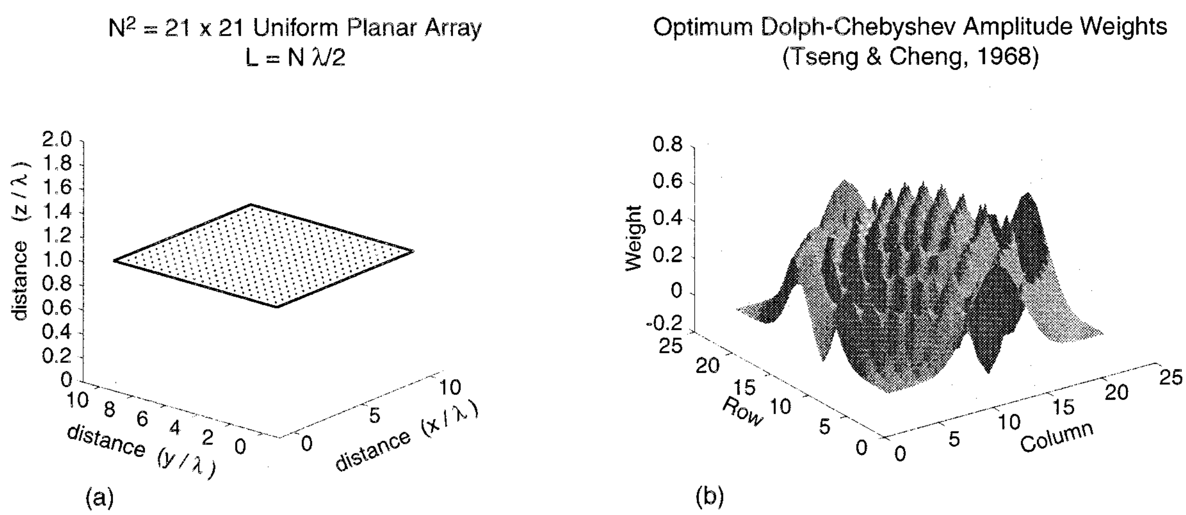

Fig. 9. (a) Uniform square planar array with 21 × 21 elements spaced $\lambda/2$ apart. $L = N(\lambda/2)$. (b) Optimum Dolph–Chebyshev amplitude weights [19, 20] for the uniform planar array in (a).

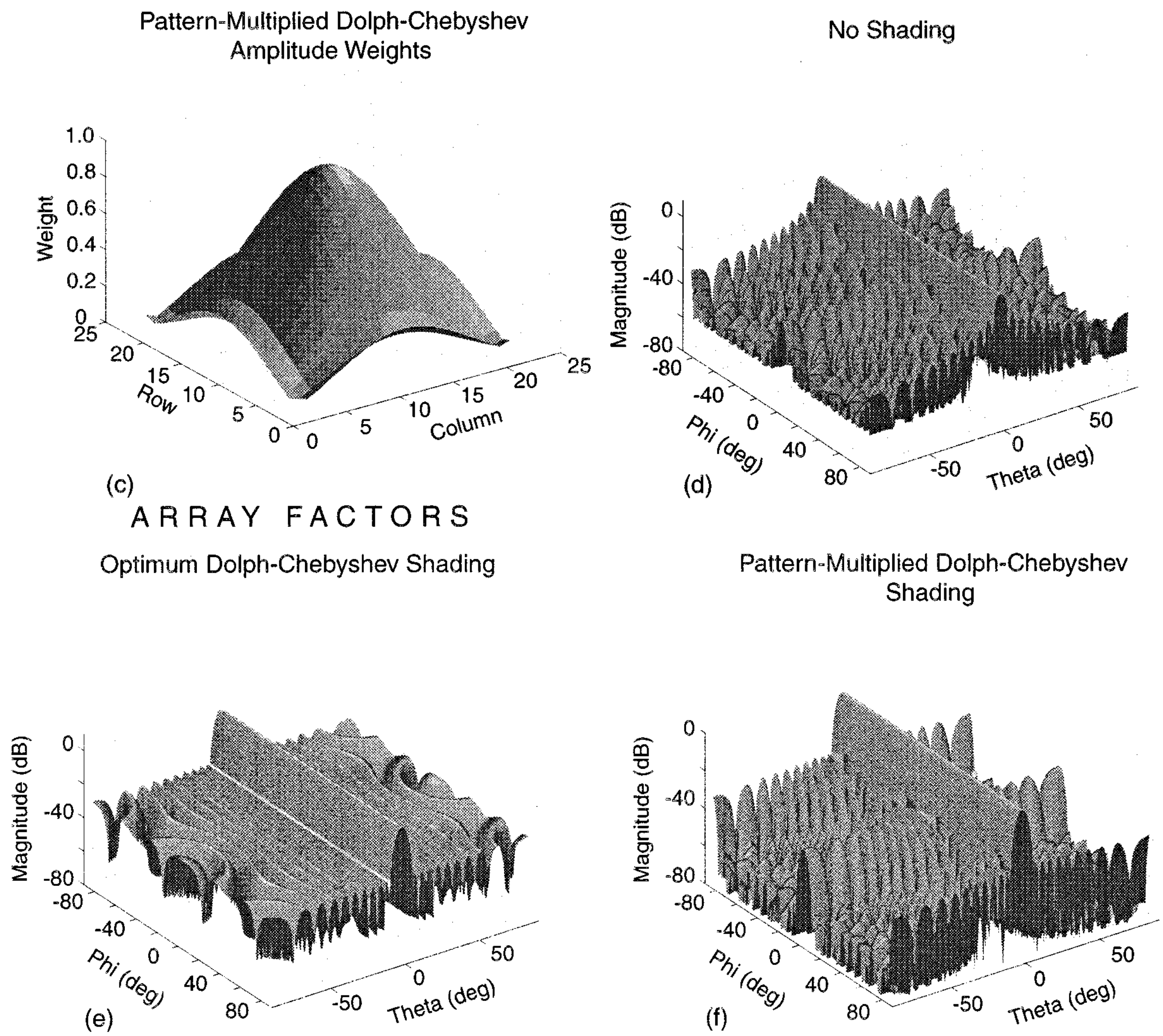

Fig. 9. *(Continued.)* (c) Amplitude weights obtained by pattern-multiplication of the Dolph-Chebyshev amplitude weights for a 21-element ULA with $\lambda/2$ element spacing. Array factors for the array in (a). (d) Without shading; (e) With the optimum Dolph–Chebyshev amplitudes of (b). (f) With the pattern-multiplied Dolph–Chebyshev amplitudes of (c).

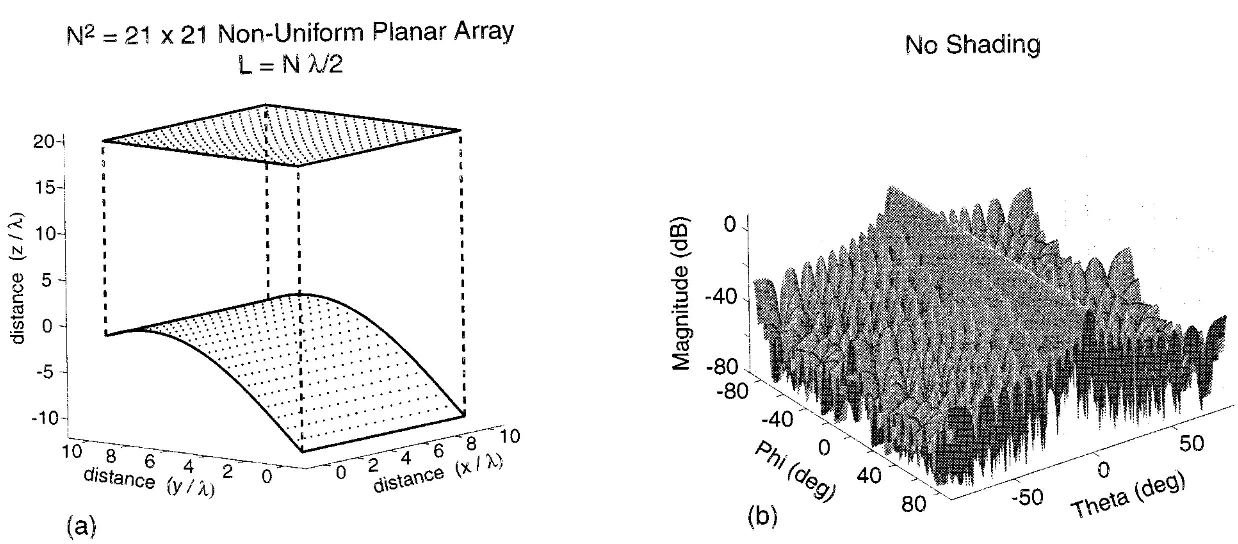

Fig. 10. (a) Noncoplanar array on a partial-cylinder, projected to a square planar array with $N \times M$ =21 ×21 nonuniformly spaced elements and length and width $L = N(\lambda/2)$. Array factors: (b) without shading.

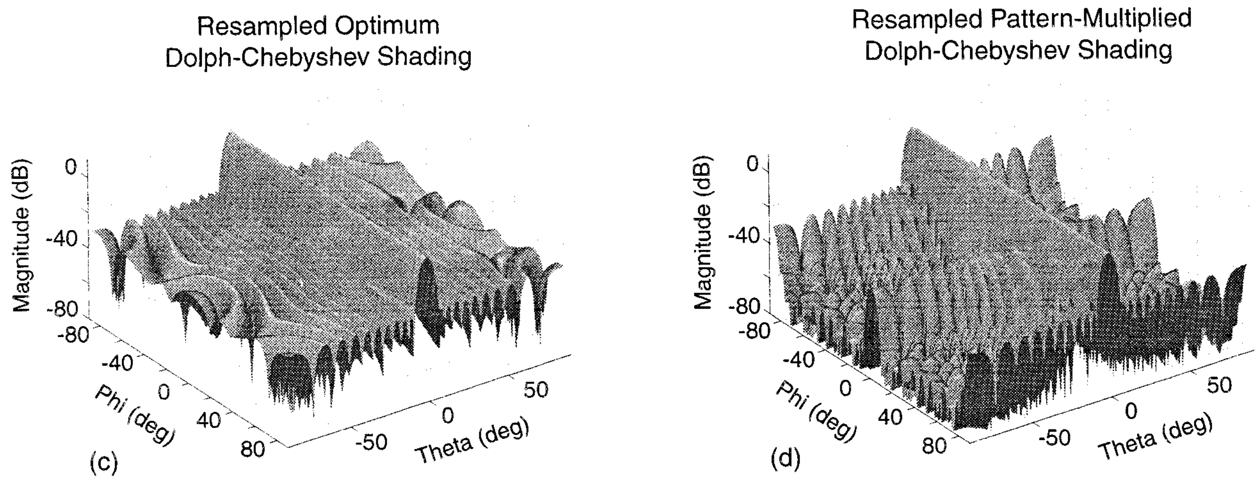

Fig. 10. *(Continued.)* (c) With resampling of the optimum Dolph–Chebyshev amplitudes for the equivalent uniform square planar array [e.g., Fig. 9(a) and (b)]; (d) with resampling the pattern-multiplied Dolph–Chebyshev amplitudes for the equivalent uniform square planar array [e.g., Fig. 9(a) and (c)].

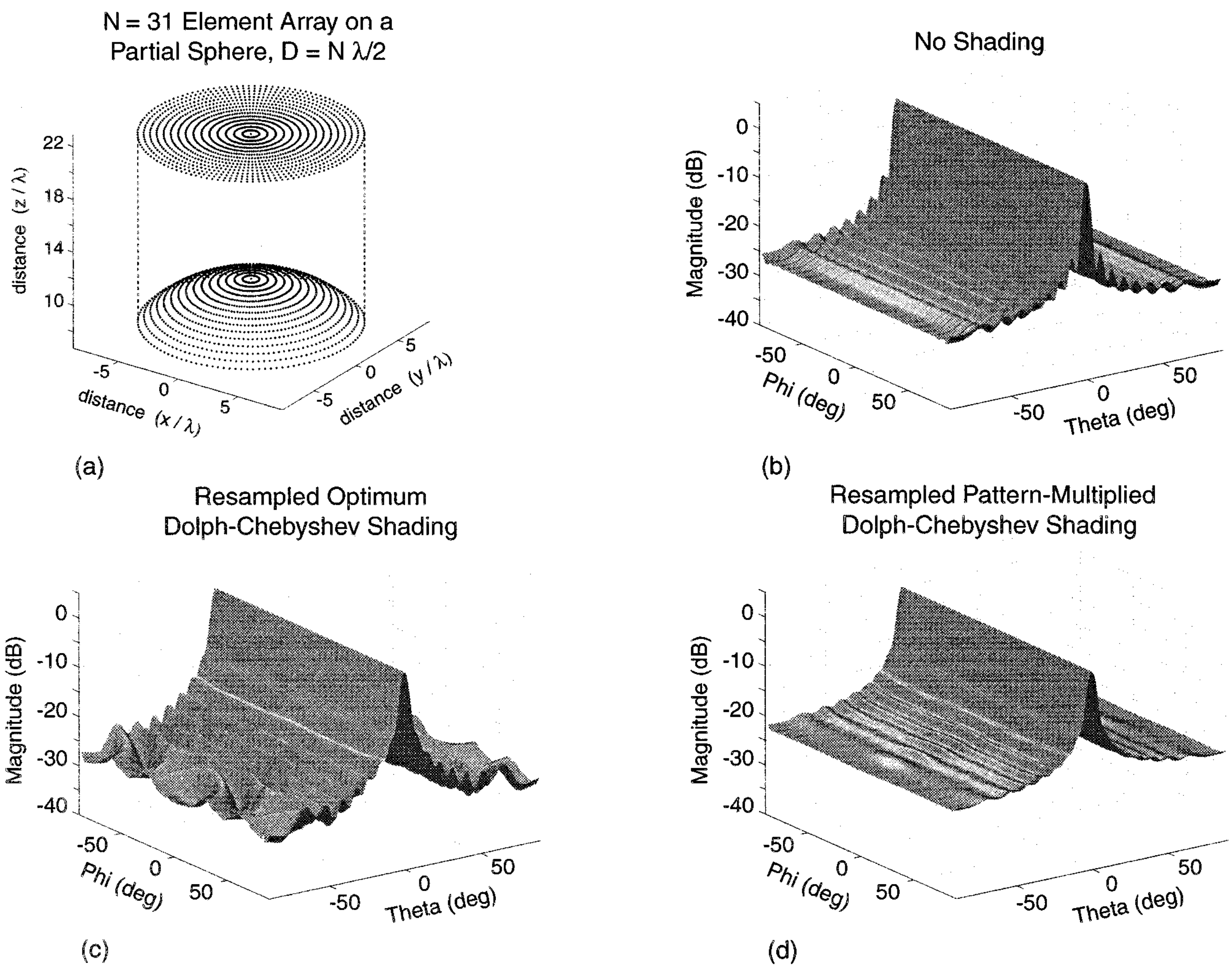

Fig. 11. (a) Noncoplanar array on a partial-sphere, projected to a circular-planar array with $N = 31$ nonuniformly spaced elements across the diameter with length $L = N(\lambda/2)$. Array factors: (b) without shading; (c) with resampling and truncating the optimum Dolph–Chebyshev amplitudes for the equivalent uniform square planar array [e.g., Fig. 9(a) and (b)]; (d) with resampling and truncating the pattern-multiplied Dolph–Chebyshev amplitudes for the equivalent uniform square planar array [e.g., Fig. 9(a) and (c)].

TABLE I

PERFORMANCE OF SHADING TECHNIQUES FOR COMPUTER SIMULATIONS OF UNIFORM PLANAR AND NONCOPLANAR ARRAYS. THE UNIFORM ARRAYS ARE SQUARE WITH $N \times N$ ELEMENTS AND LENGTHS $L = N\lambda/2$. WHEN PROJECTED TO PLANES TANGENT TO THEIR SURFACES, PARTIAL- AND HALF-CYLINDER ARRAYS ARE SQUARES WITH LENGTHS $L = N\lambda/2$. THE PROJECTIONS OF PARTIAL AND HEMISPHERE ARRAYS HAVE DIAMETERS $D = N\lambda/2$. θ AND ϕ ARE AZIMUTH ANGLES, RESPECTIVELY

		21×21-element uniform planar square array (Figure 9)		21×21-element non-coplanar array on a partial cylinder (Figure 10)		31×31-element uniform planar square array (not shown)		31×31-element non-coplanar array on a half cylinder (not shown)		31-element diameter non-coplanar array on a partial sphere (Figure 11)		61-element diameter non-coplanar array on a hemisphere (not shown)	
		φ=0°	φ=45°	φ=0°	φ=45°	φ=0°	φ=45°	φ=0°	φ=45°	φ=0°	φ=45°	φ=0°	φ=45°
-3dB BW (deg)	no shading	4.84	4.84	4.85	4.90	3.25	3.25	3.25	3.30	4.80	4.80	1.84	1.84
	-30dB uniform DC	6.00	6.00	5.95	6.00	4.02	4.02	3.90	3.97	5.20	5.20	2.10	2.00
	resampled -30dB uniform DC	NA	NA	5.95	6.00	NA	NA	3.90	3.97	5.20	5.20	2.15	2.15
	pattern multiplied -30dB uniform DC	6.00	6.05	5.95	6.05	4.02	4.05	3.90	4.00	5.70	5.70	2.50	2.48
	resampled pattern multiplied -30dB uniform DC	NA	NA	5.95	6.05	NA	NA	3.90	4.00	5.70	5.70	2.50	2.50
PSLL (dB)	no shading	-13.3	-26.0	-12.5	-25.2	-13.3	-26.0	-15.6	-24.6	-15.1	-15.1	-14.7	-14.7
	-30dB uniform DC	-30.0	-30.0	-23.6	-29.1	-30.0	-30.0	-21.8	-29.4	-11.5	-12.9	-10.7	-11.7
	resampled -30dB uniform DC	NA	NA	-26.3	-28.2	NA	NA	-24.8	-27.5	-12.9	-12.9	-11.4	-12.2
	pattern multiplied -30dB uniform DC	-30.0	-60.0	-23.6	-53.8	-30.0	-60.0	-21.8	-52.1	-11.5	-12.9	-12.2	-12.8
	resampled pattern multiplied -30dB uniform DC	NA	NA	-26.3	-56.5	NA	NA	-24.8	-55.2	-12.4	-12.4	-12.6	-13.1
NPG	no shading	1.00		1.00		1.00		1.00		1.00		1.00	
	-30dB uniform DC	0.67		0.67		0.58		0.58		0.76		0.47	
	resampled -30dB uniform DC	NA		0.69		NA		0.53		0.85		0.61	
	pattern multiplied -30dB uniform DC	0.75		0.75		0.77		0.77		0.85		0.80	
	resampled pattern multiplied -30dB uniform DC	NA		0.75		NA		0.75		0.85		0.81	