Errata: Electromagnetic diffraction analysis of columned grid gratings

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CORRIGENDUM

Errata: Electromagnetic diffraction analysis of columned grid gratings

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Abstract
Some numerical results in electromagnetic diffraction analysis of columned grid gratings were incorrect. Corrected numerical results are obtained by use of the exact Fourier factorization and presented in this paper.

Keywords: columned grating, couple-wave analysis, Fourier modal method, antireflection, diffraction optics

(Some figures in this article are in colour only in the electronic version)

After the paper in [1] was published, we were told that an early study on the electromagnetic diffraction of columned grid grating had been reported in [2], and a series of new formulations of the Fourier modal method (FMM, or the rigorous vector coupled-wave theory in [1]) for a two-dimensional crossed grating had been reported in [3] as well. The improvement of these new formulas was mainly the calculation of the block-Toeplitz matrix (BTM) consisting of Fourier coefficients of the permittivity function ϵ, where the correct rules of Fourier factorization were applied. With these new formulas, an FMM can produce fast-converging numerical results. As proposed in [3], the majority of the FMM program remained unaltered, but the BTM of $1/\epsilon$ was replaced with the inverse matrix of the BTM of ϵ, and the BTMs containing ϵ were computed with equations (8) and (9), respectively, in [3], which generally had to be obtained by the use of a numerical integral method instead of the analytical expression of equation (13). The complete programs were coded in Matlab (The Mathworks, Natick, MA, USA) by applying Fourier factorization, as in [3]. With the fast development of personal computer technology, we have now been able to calculate the examples in [1] with the higher truncation orders M and N for the series indices m and n in the electromagnetic field expansions, where M and N are odd integers, i.e. $|m| < (M+1)/2$ and $|n| < (N+1)/2$.

In figure 1(b), R should denote the diameter of the column. Figures 5, 7, 8, 9 and 13 should be replaced by the following figures. In the text of page 183, for the silicon grating, when the minimum reflectivity can be obtained, the column diameter of $0.71T$ should be replaced by that of $0.8T$ in figure 5, and the grating depth should be 0.21λ instead of 0.16λ in figure 7. In the caption for figure 12, the character ϕ should be δ.

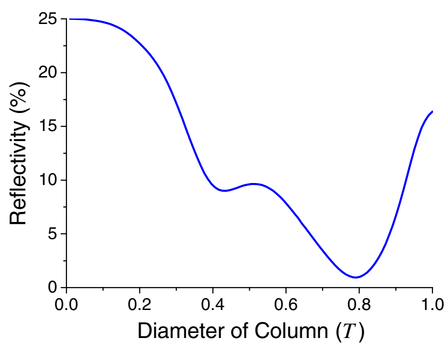

Figure 5. Relation between reflectivity and column diameter for a silicon substrate, with parameters: $T = 0.69\lambda$; $h = 0.16\lambda$; $\psi = 90°$; $\alpha = \delta = 0°$; $n_i = 1.0$; $n_s = 3.0$; $M = N = 13$.

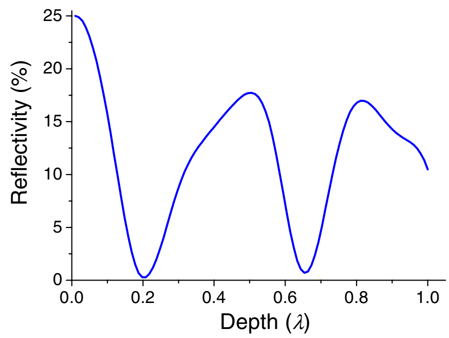

Figure 7. Relation between reflectivity and the depth of a silicon grating, with parameters: $T = 0.69\lambda$; $R = 0.71T$; $\psi = 90°$; $\alpha = \delta = 0°$; $n_i = 1.0$; $n_s = 3.0$; $M = N = 21$.

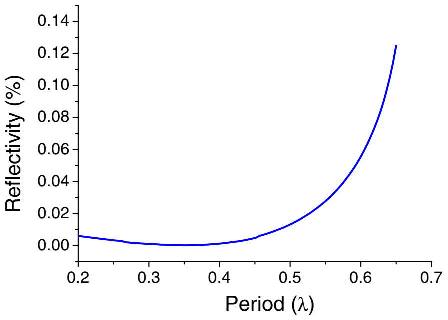

Figure 8. Relation between reflectivity and spatial period for a glass grating, with parameters: $R = 0.79T$; $h = 0.205\lambda$; $\psi = 90°$; $\alpha = \delta = 0°$; $n_i = 1.0$; $n_s = 1.5$; $M = N = 13$.

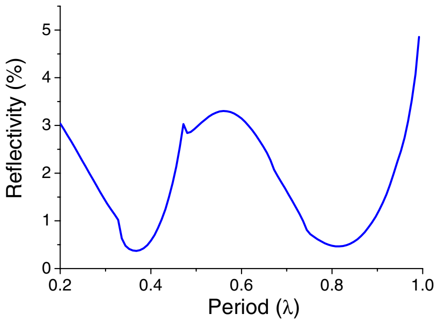

Figure 9. Relation between reflectivity and spatial period for a silicon grating, with parameters: $R = 0.70T$; $h = 0.17\lambda$; $\psi = 90°$; $\alpha = \delta = 0°$; $n_i = 1.0$; $n_s = 3.0$; $M = N = 13$;

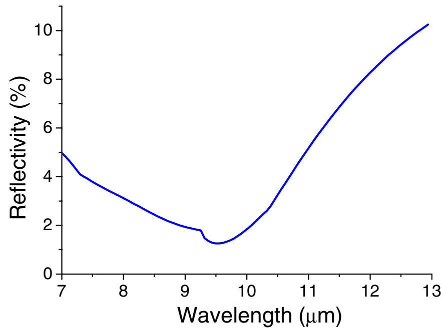

Figure 13. Diagram of reflectivity in the far-infrared wave band for a silicon grating, with parameters: $\lambda_0 = 10\ \mu$m; $T = 0.69\lambda_0$; $R = 0.79T$; $h = 0.15\lambda_0$; $\alpha = \delta = 0°$; $\psi = 90°$; $n_i = 1.0$; $n_s = 3.0$; $M = N = 21$.

Some obvious typographical errors should be pointed out as follows: equations (11), (12) and (16) should be replaced by equations (1), (2) and (3):

$$\epsilon^{-1}(x, y, z) = \sum_{p=-\infty}^{\infty} \sum_{q=-\infty}^{\infty} \overline{\epsilon}_{pq}(z) \exp\left[\mathrm{i}\left(p\frac{2\pi}{T_x}x + q\frac{2\pi}{T_y}y\right)\right], \tag{1}$$

$$\epsilon = \begin{cases} \epsilon_{\mathrm{I}} & -T_x/2 < x < T_x/2, -T_y/2 < y < T_y/2, \\ & \text{and } x^2 + y^2 > (R/2)^2 \\ \epsilon_{\mathrm{III}} & x^2 + y^2 < (R/2)^2, \end{cases} \tag{2}$$

$$\eta_{mn}^{\mathrm{III}} = \mathrm{Re}\,(k_{zmn}^{\mathrm{III}}/k_{z00}^{\mathrm{III}})|T_{mn}|^2, \tag{3}$$

respectively. In equation (2), ϵ_{I} and ϵ_{III} are the permittivities of region I and region III, respectively. In addition, the symbols e_1, e_2, and e_3 in equations (13) and (14) should also be replaced by ϵ_{I}, ϵ_{III}, and ϵ_{III}, respectively.

Acknowledgments

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References

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