applied optics

Simple and accurate expressions for diffuse reflectance of semi-infinite and two-layer absorbing and scattering media: erratum

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Received 4 June 2015; posted 15 June 2015 (Doc. ID 242101); published 1 July 2015

A previous paper [Appl. Opt. 48, 6670 (2009)] presented analytical expressions for the diffuse reflectance of semi-infinite homogeneous and two-layer refracting, absorbing, and anisotropically scattering media exposed to normal and collimated light. It also reported various regression coefficients associated with the analytical expressions obtained by fitting the diffuse reflectance predicted from Monte Carlo (MC) simulations. Although the formulation and the MC simulation results were correct, the values of some regression coefficients were erroneously reported. This erratum points out the error in the original paper and reports the correct values. It also presents alternative expressions for when the medium has an index of refraction of 1.44, corresponding to the human skin in the visible portion of the spectrum.

OCIS codes: (010.5620) Radiative transfer; (170.0170) Medical optics and biotechnology; (170.3660) Light propagation in tissues; (160.1190) Anisotropic optical materials; (000.4430) Numerical approximation and analysis; (230.4170) Multilayers.

http://dx.doi.org/10.1364/AO.54.006116

1. INTRODUCTION

This erratum aims to correct mistakes made in reporting the values of the regression coefficients used in the analytical expressions derived for the diffuse reflectance of semi-infinite homogeneous and two-layer refracting, absorbing, and anisotropically scattering media developed in [1]. Note that the derivation of these analytical expressions remains valid.

2. REGRESSION COEFFICIENTS FOR SEMI-INFINITE MEDIUM

In Section 4.A of the original manuscript [1], the reflectivity $\hat{\rho}_{10}(\omega_{\mathrm{tr}})$ and the reflectance $\hat{R}_d(\omega_{\mathrm{tr}})$ necessary for calculating the diffuse reflectance $R\_(\omega_{\mathrm{tr}})$ of a semi-infinite homogeneous medium [Eq. (25)] were, respectively, given by Eq. (26) and Eq. (27) as N-order polynomials in terms of $a(\omega_{\mathrm{tr}})$. The regression coefficients $(A_i)_{0\le i\le N}$ in Eq. (26) and $(B_i)_{0\le i\le N}$ in Eq. (27) were reported in Table 1 for third-order polynomials, i.e., $N = 3$ [1]. Unfortunately, these coefficients were erroneously reported.

Table E1 reports the correct values of the regression coefficients for $n_1 = 1.00$, 1.33, 1.44, 1.77, and 2.00. The associated error between the diffuse reflectance $R\_(\omega_{\mathrm{tr}})$ predicted by Eq. (25) with the revised regression coefficients and the diffuse reflectance obtained using the Monte Carlo method was less than 1% for all refractive indices considered.

3. REGRESSION COEFFICIENTS FOR TWO-LAYER MEDIUM

In Section 4.C of the original manuscript [1], the parameter $1/\alpha$ appearing in the expression of the reduced reflectance R^* given by Eq. (33) was expressed as a third-order polynomial in term of $\omega_{\mathrm{tr},2}$ and given by Eq. (35) as

$$1/\alpha = C(n_1)\omega_{\mathrm{tr},2}^2 + D(n_1)\omega_{\mathrm{tr},2} + E(n_1). \quad \textbf{(35)}$$

Unfortunately, the values of the regression coefficients $C(n_1)$, $D(n_1)$, and $E(n_1)$ in Table 2 of the original manuscript [1] were erroneously reported. Table E2 reports the correct values of regression coefficients for $n_1 = 1.00$, 1.33, and 1.44.

4. ALTERNATIVE EXPRESSIONS FOR $R\_(\omega_{\mathrm{tr}})$ AND $1/\alpha$

The diffuse reflectance $R\_(\omega_{\mathrm{tr}})$ of semi-infinite homogeneous medium, originally given by Eq. (25) [1], can alternatively be expressed, for refractive index $n_1 = 1.44$, as

$$R\_(\omega_{\mathrm{tr}}) = -0.0247 + 0.0137\exp(2.873\omega_{\mathrm{tr}}^{1.64}) + \frac{0.0116}{1.02 - \omega_{\mathrm{tr}}}. \quad \textbf{(E1)}$$

Similarly, an alternative expression for $1/\alpha$ originally given by Eq. (35) can be expressed, for $n_1 = 1.44$, as

Table E1. Revised Values of the Regression Coefficients $(A_i)_{0\le i\le N}$ and $(B_i)_{0\le i\le N}$ Used in Eqs. (26) and (27) of [1] to Estimate the Diffuse Reflectance R_- of a Semi-infinite Homogeneous Medium with Index of Refraction $n_1 = 1.00$, 1.33, 1.44, 1.77, and 2.00

n_1	$i =$	0	1	2	3
1.00	$A_i =$	0.1000	0.1000	0.0246	−0.0078
1.00	$B_i =$	−0.0016	0.0105	−0.0051	3.7797×10^{-4}
1.33	$A_i =$	0	0.1515	−0.0135	0
1.33	$B_i =$	0.0300	0.0199	0.0019	-4.6164×10^{-4}
1.44	$A_i =$	−0.0025	0.0952	0.0046	−0.0025
1.44	$B_i =$	0.0100	0.0326	−0.0079	4.1200×10^{-4}
1.77	$A_i =$	−0.0059	0.0809	−0.0041	-6.3080×10^{-4}
1.77	$B_i =$	0.0100	0.0474	−0.0087	3.1662×10^{-4}
2.00	$A_i =$	−0.0129	0.0659	−0.0040	-3.0925×10^{-4}
2.00	$B_i =$	0.0200	0.0152	0.0071	−0.0011

Table E2. Revised Values of the Regression Coefficients $C(n_1)$, $D(n_1)$, and $E(n_1)$ in the Expression of $1/\alpha$ Given by Eq. (35) for Refraction Index n_1 Equals to 1.0, 1.33, and 1.44

n_1	C	D	E
1.00	0.1805	−0.2445	0.7266
1.33	−0.3226	−0.0503	0.8946
1.44	−0.2789	−0.3854	1.1537

$$1/\alpha = 2.562 - \frac{4.263}{3.050 - \omega_{\mathrm{tr},2}}. \quad \textbf{(E2)}$$

These alternative expressions, applicable to human skin, have the advantage of being rapidly computed compared with the original formulation involving multiple stages and several polynomials. This aspect is important in the context of inverse methods when the forward problem has to be computed numerous times. These expressions were used in our subsequent publications [2–4], which were not affected by the errors made in Tables 1 and 2 of [1].

For the reader's convenience, an Excel spreadsheet evaluating the semi-empirical expression for the diffuse reflectance of semi-infinite media and the corrected empirical parameter $1/\alpha$ for two-layer media are available in digital form online [5] or directly from the corresponding author upon request.

Funding. Seoul Viosys.

Acknowledgment. We are grateful to Dr. Stella Park from Seoul Viosys and Prof. Hong Qi from Harbin Institute of Technology for bringing these problems to our attention.

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