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Estimation of Jones matrix, birefringence and entropy using Cloude-Pottier decomposition in polarization-sensitive optical coherence tomography: erratum

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Abstract: An erratum is presented to correct errors in the equations in [Biomed. Opt. Express **7**(9), 3551–3573 (2016)].

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References and links

1. M. Yamanari, S. Tsuda, T. Kokubun, Y. Shiga, K. Omodaka, N. Aizawa, Y. Yokoyama, N. Himori, S. Kunimatsu-Sanuki, K. Maruyama, H. Kunikata, and T. Nakazawa, "Estimation of Jones matrix, birefringence and entropy using Cloude-Pottier decomposition in polarization-sensitive optical coherence tomography," Biomed. Opt. Express **7**(9), 3551–3573 (2016).

In our paper [1], several errors in the equations have been found and are corrected as below.

Equation (22) of [1] should read

$$H_{noise}\left(\underline{E_i}\right)=\sum_{j=1}^{2}-\zeta_j^{(i)}\log_4\left(\zeta_j^{(i)}\right), \tag{22}$$

where the negative sign and the base 4 of the logarithm were described correctly. We note that the same base of the logarithm has to be used for the entropy throughout the processing flow.

In addition, Eq. (28) was erroneously presented in [1], which algebraically resulted in 1 regardless of the signals and noises. It was related to the erroneous definition of Eq. (27) in [1]. Equation (27) should be defined to include the bias of the noises as

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$$\begin{bmatrix} s_0''^{(1)} \\ s_1''^{(1)} \\ s_2''^{(1)} \\ s_3''^{(1)} \end{bmatrix} := \begin{bmatrix} \overline{|g_{1H}|^2} + \overline{|g_{1V}|^2} \\ \overline{|g_{1H}|^2} - \overline{|g_{1V}|^2} \\ 2\,\mathrm{Re}\left[\overline{g_{1H} g_{1V}^*}\right] \\ 2\,\mathrm{Im}\left[\overline{g_{1H} g_{1V}^*}\right] \end{bmatrix} = \begin{bmatrix} \overline{|g_{1H}|^2} + \overline{|g_{1V}|^2} \\ \overline{|g_{1H}|^2} - \overline{|g_{1V}|^2} \\ 2\,\mathrm{Re}\left[\overline{E_{1H} E_{1V}^*}\right] \\ 2\,\mathrm{Im}\left[\overline{E_{1H} E_{1V}^*}\right] \end{bmatrix} = \begin{bmatrix} \overline{|g_{1H}|^2} + \overline{|g_{1V}|^2} \\ \overline{|g_{1H}|^2} - \overline{|g_{1V}|^2} \\ 2\overline{|E_{1H}|}\,\overline{|E_{1V}|}\cos\delta \\ 2\overline{|E_{1H}|}\,\overline{|E_{1V}|}\sin\delta \end{bmatrix}$$
$$= \begin{bmatrix} \overline{|g_{1H}|^2} + \overline{|g_{1V}|^2} \\ \overline{|g_{1H}|^2} - \overline{|g_{1V}|^2} \\ 2\sqrt{\overline{|g_{1H}|^2} - \overline{|n_{1H}|^2}}\sqrt{\overline{|g_{1V}|^2} - \overline{|n_{1V}|^2}}\cos\delta \\ 2\sqrt{\overline{|g_{1H}|^2} - \overline{|n_{1H}|^2}}\sqrt{\overline{|g_{1V}|^2} - \overline{|n_{1V}|^2}}\sin\delta \end{bmatrix}, \quad (27)$$

which is based on Eq. (25) of [1]. Equation (28) of [1] should then read

$$P^{(1)} = \frac{\sqrt{\left\{s_1''^{(1)}\right\}^2 + \left\{s_2''^{(1)}\right\}^2 + \left\{s_3''^{(1)}\right\}^2}}{s_0''^{(1)}}$$
$$= \frac{\sqrt{\left(\overline{|g_{1H}|^2} - \overline{|g_{1V}|^2}\right)^2 + 4\left(\overline{|g_{1H}|^2} - \overline{|n_{1H}|^2}\right)\left(\overline{|g_{1V}|^2} - \overline{|n_{1V}|^2}\right)}}{\overline{|g_{1H}|^2} + \overline{|g_{1V}|^2}}. \quad (28)$$

Consequently, Eqs. (43)-(46) of [1] should read

$$P^{(\underline{\varepsilon_1})} = \frac{\sqrt{\left(\overline{|\varepsilon_{1H}|^2} - \overline{|\varepsilon_{1V}|^2}\right)^2 + 4\left(\overline{|\varepsilon_{1H}|^2} - \mathrm{Var}(\varepsilon_{1H})\right)\left(\overline{|\varepsilon_{1V}|^2} - \mathrm{Var}(\varepsilon_{1V})\right)}}{\overline{|\varepsilon_{1H}|^2} + \overline{|\varepsilon_{1V}|^2}}, \quad (43)$$

$$P^{(\underline{\varepsilon_2})} = \frac{\sqrt{\left(\overline{|\varepsilon_{2H}|^2} - \overline{|\varepsilon_{2V}|^2}\right)^2 + 4\left(\overline{|\varepsilon_{2H}|^2} - \mathrm{Var}(\varepsilon_{2H})\right)\left(\overline{|\varepsilon_{2V}|^2} - \mathrm{Var}(\varepsilon_{2V})\right)}}{\overline{|\varepsilon_{2H}|^2} + \overline{|\varepsilon_{2V}|^2}}, \quad (44)$$

$$P^{(\underline{\varepsilon_1}|\underline{\varepsilon_2})} = \frac{\sqrt{\left(\overline{|\varepsilon_{1H}|^2} - \overline{|\varepsilon_{1V}|^2}\right)^2 + 4\left(\overline{|\varepsilon_{1H}|^2} - \mathrm{Var}(\varepsilon_{1H} \mid \underline{\varepsilon_2})\right)\left(\overline{|\varepsilon_{1V}|^2} - \mathrm{Var}(\varepsilon_{1V} \mid \underline{\varepsilon_2})\right)}}{\overline{|\varepsilon_{1H}|^2} + \overline{|\varepsilon_{1V}|^2}}, \quad (45)$$

$$P^{(\underline{\varepsilon_2}|\underline{\varepsilon_1})} = \frac{\sqrt{\left(\overline{|\varepsilon_{2H}|^2} - \overline{|\varepsilon_{2V}|^2}\right)^2 + 4\left(\overline{|\varepsilon_{2H}|^2} - \mathrm{Var}(\varepsilon_{2H} \mid \underline{\varepsilon_1})\right)\left(\overline{|\varepsilon_{2V}|^2} - \mathrm{Var}(\varepsilon_{2V} \mid \underline{\varepsilon_1})\right)}}{\overline{|\varepsilon_{2H}|^2} + \overline{|\varepsilon_{2V}|^2}}. \quad (46)$$

In Eq. (28), $\overline{|g_{1H}|^2} - \overline{|n_{1H}|^2}$ and $\overline{|g_{1V}|^2} - \overline{|n_{1V}|^2}$ should be non-negative in principle, but can be negative in practice. If these parameters are negative in the data processing, they are set as zero to avoid physically undefined values of $P^{(1)}$. Similar operations are also applied to Eqs. (43)-(46).

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In addition, the last sentence of Section 2.5 shown in the following should be deleted because it was presented incorrectly and did not make sense in [1]; "The absolute-squared expected values of the matrix elements in Eq. (24) or (29) that are used in Eqs. (35)-(42) are calculated as $\overline{|g_{1\mathrm{H}}|}^2 - \overline{|n_{1\mathrm{H}}|}^2$ and similarly for all other elements."

Since all of the equations were correctly implemented in our processing software of [1], no change is required in the results.