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Transport of intensity equation: A tutorial" Optics and Lasers in Engineering

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DISCLAIMER

Corrigendum to "Transport of intensity equation: a tutorial" Optics and Lasers in Engineering, Volume 135 (2020) 106187

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In this Corrigendum, we correct misprints in equations and figures of the article titled "Transport of intensity equation: a tutorial" Optics and Lasers in Engineering, 135, 106187, 2020.[1] These misprints were caused by unanticipated issues in email communication between the authors and the editorial team during the proofreading stage. The authors would like to apologize for any inconvenience caused.

1. EQUATION CORRECTIONS

The authors regret that the Equations 59, 60, 73, 90, 105, 223, 248, 324, 329, 366, 389, and 394 provided in the concerned paper contain typos. The correct formulas are summarized as follows.

$$U_i(\mathbf{x}) = U_0(\mathbf{x}) \otimes h(\mathbf{x}) \tag{59}$$

$$I_i(\mathbf{x}) = U_i(\mathbf{x}) U_i^*(\mathbf{x}) = \left|U_0(\mathbf{x}) \otimes h(\mathbf{x})\right|^2 \tag{60}$$

$$\bar{z} = 2k\left(1 - \sqrt{1 - NA^2}\right)\Delta z \overset{paraxial}{\approx} kNA^2\Delta z \tag{73}$$

$$\begin{aligned}\hat{I}_{\Delta z}(\mathbf{u}) = \hat{I}_{\Delta z}^{\phi=0}(\mathbf{u}) + 2\left[\sin\left(\pi\lambda\Delta z|\mathbf{u}|^2\right) - \pi\lambda\Delta z|\mathbf{u}|^2\cos\left(\pi\lambda\Delta z|\mathbf{u}|^2\right)\right] \\ \mathscr{F}\left\{I_0(\mathbf{x})\phi(\mathbf{x})\right\} - \cos\left(\pi\lambda\Delta z|\mathbf{u}|^2\right)\frac{\lambda\Delta z}{2\pi}\mathscr{F}\left\{\nabla\cdot\left[I_0(\mathbf{x})\nabla\phi(\mathbf{x})\right]\right\}\end{aligned} \tag{90}$$

$$U(\mathbf{x},t) = U(\mathbf{x})\exp(-j\omega_0 t) = A(\mathbf{x})\exp\left[j\left(\phi(\mathbf{x}) - \omega_0 t\right)\right] \tag{105}$$

$$\tan\theta = -\lambda\Delta z \tag{223}$$

$$\hat{T}(\mathbf{u}_1)\hat{T}^*(\mathbf{u}_2) = a_0^2\delta(\mathbf{u}_1)\delta(\mathbf{u}_2) + a_0\delta(\mathbf{u}_2)\left[\hat{\eta}(\mathbf{u}_1) + j\hat{\phi}(\mathbf{u}_1)\right] + a_0\delta(\mathbf{u}_1)\left[\hat{\eta}(\mathbf{u}_2) - j\hat{\phi}(\mathbf{u}_2)\right] \tag{248}$$

$$\begin{aligned}\hat{U}_{3D}(u_x,u_y,u_z)&=\int \hat{U}_{2D}(u_x,u_y,0)e^{j2\pi z\sqrt{\left(\frac{1}{\lambda}\right)^2-u_x^2-u_y^2}}e^{-j2\pi z u_z}dz\\&=\int \hat{U}_{2D}(u_x,u_y,0)e^{-j2\pi z\left(u_z-\sqrt{\left(\frac{1}{\lambda}\right)^2-u_x^2-u_y^2}\right)}dz\\&=\hat{U}_{2D}(u_x,u_y,0)\delta\left(u_z-\sqrt{\left(\frac{1}{\lambda}\right)^2-u_x^2-u_y^2}\right)\end{aligned} \tag{324}$$

$$H(\rho,l)=\int P(\rho)\,e^{jkz\sqrt{1-\lambda^2\rho^2}}e^{-j2\pi z\eta}dz=P(\rho)\,\delta\left(\eta-\sqrt{\left(\frac{1}{\lambda}\right)^2-\rho^2}\right) \tag{329}$$

$$\begin{aligned}I(\mathbf{r})=W_I(\mathbf{r},\mathbf{r})=\iint & W_S(\mathbf{r}_1,\mathbf{r}_2)\,T(\mathbf{r}_1)\,T_s^*(\mathbf{r}_2)\\ & h(\mathbf{r}-\mathbf{r}_1)\,h^*(\mathbf{r}-\mathbf{r}_2)\,d\mathbf{r}_1 d\mathbf{r}_2\end{aligned} \tag{366}$$

$$I_z(\mathbf{r})=\int I(\mathbf{u})\,e^{j2\pi z\eta}d\eta \tag{389}$$

$$\hat{P}(\mathbf{u})=\frac{\left[\hat{I}(\mathbf{u})-B\delta(\mathbf{u})\right]H_P^*(\mathbf{u})}{|H_P(\mathbf{u})|^2+\beta} \tag{394}$$

2. FIGURE CORRECTIONS

In the original published version of this article, Figures 26, 63, and 101 were incorrectly processed or displayed. Please find the correct figures below.

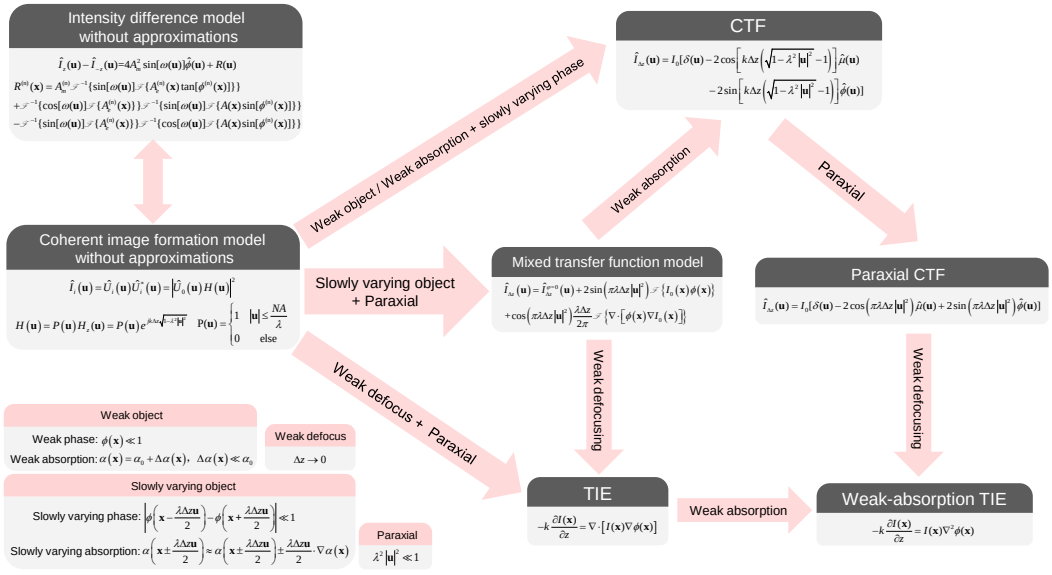

Figure 26. Mathematical models, establishment conditions, and the intrinsic relationship of different phase retrieval algorithms

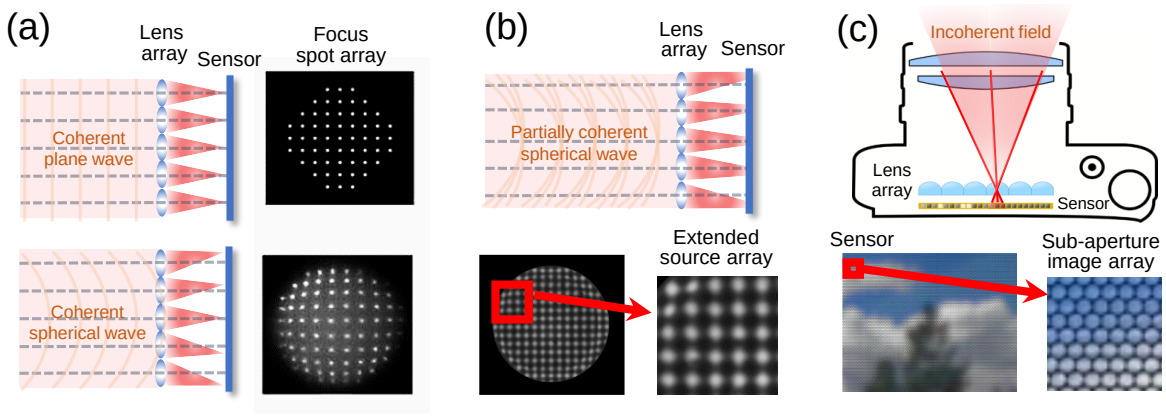

Figure 63. Principle of the Shack-Hartmann sensor and light-field camera. (a) For coherent field, the Shack-Hartmann sensor forms a focus spot array sensor signal; (b) for a partially coherent field, the Shack-Hartmann sensor forms an extended source array sensor signa; (c) for incoherent imaging, the light-field camera produces a 2D sub-aperture image array.

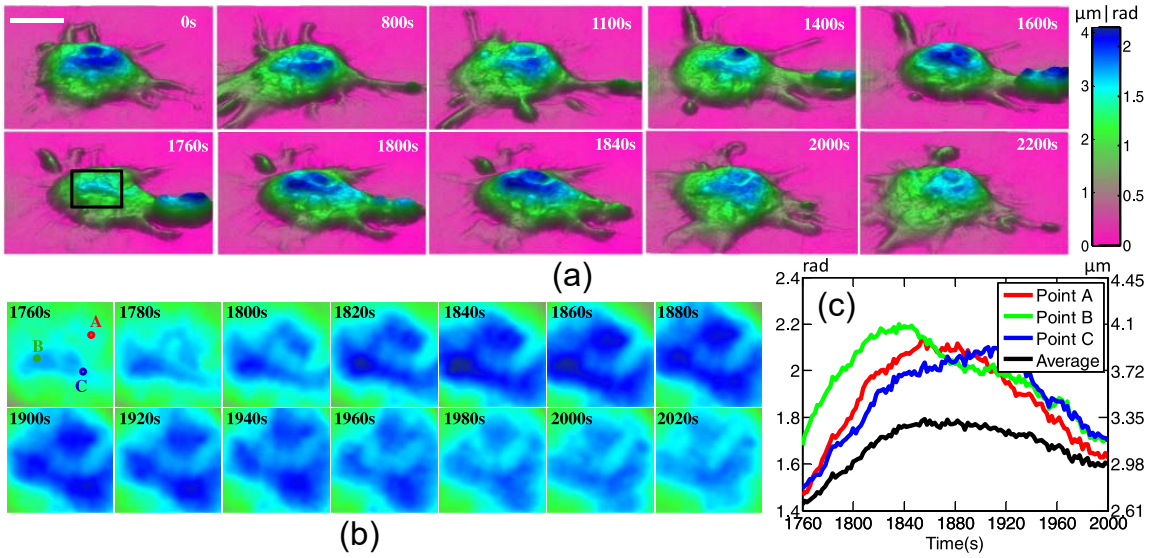

Figure 102. Dynamic TIE phase imaging of macrophage phagocytosis. (a) Color-coded phase profiles at different stages of phagocytosis; (b) phase maps of the nuclear region of the macrophage—the black square in (a)—during the internalization stage of phagocytosis; (c) phase/thickness variation with time of three points, indicated by the dots in (b): (A) red, (B) green, and (C) blue, and the average of the whole square region (bottom, black curve). Scale bar: 10 μm.

3. TEXT CORRECTIONS

The authors also regret that the following text typos in the concerned article:

1. In the caption of Fig. 1 of original article, “A example” and “A exchange” should be “An example” and “An exchange”, respectively.

2. In the last paragraph of Page 4 left column of original article, “A major branch of interferometric phase measurement techniques is...” should be “A major branch of non-interferometric phase measurement techniques is...”.

3. In the last paragraph of Page 17 left column of original article, "In this case, they proven that the solution to TIE..." should be "In this case, they proved that the solution to TIE...".

4. In the upper line of Eq.(75) of in the original article "the paraxial coherent transfer function of Eq. (67) can be rewritten as", the equation number should be Eq.(71) instead of Eq.(67).

5. In the upper paragraph of Eq.(90) of in the original article "Therefore, the phase cannot be directly retrieved based on on-step deconvolution based on the PTF...", "on-step" should be "one-step" in this sentence.

6. In the upper paragraph of Eq.(160) of in the original article, the sentence "When $\sigma_s \gg \sigma_g$, the source is spatially coherent, and when $\sigma_s \ll \sigma_g$, the source is almost spatially incoherent" should be "When $\sigma_s \gg \sigma_g$, the source is spatially incoherent, and when $\sigma_s \ll \sigma_g$, the source is almost spatially coherent".

7. In the upper line of Eq.(163) of in the original article, "an plane" should be "a plane".

8. The title of subsection 6.3.1 should be "Ideal imaging model under partially coherent illumination".

9. In the first paragraph of Page 63 left column of original article, "However, it requires elaborate optical setups (Fig. 49) and significantly sacrifices..." should be "However, it requires elaborate optical setups (Fig. 63) and significantly sacrifices...".

10. In the last paragraph of Page 70 right column of original article, "Eq. (328) is quite similar to..." should be "Eq. (329) is quite similar to...".

11. In the next paragraph of eq.(181) "(see Subsection 6.2.5 for details)", the subsection number should be Subsection 6.2.6 instead of Subsection 6.2.5.

12. In the upper line of Eq.(393) "the absorption is assumed to be proportional to RI $\hat{P}(\mathbf{u}) \approx \varepsilon \hat{A}(\mathbf{u})$" should be $\hat{A}(\mathbf{u}) \approx \varepsilon \hat{P}(\mathbf{u})$.

13. In the first paragraph of Subsection 9.4.1, the sentence "...Köhler illumination of a off-the-shelf microscope." should be "...Köhler illumination of an off-the-shelf microscope."

REFERENCES

[1] C. Zuo, J. Li, J. Sun, Y. Fan, J. Zhang, L. Lu, R. Zhang, B. Wang, L. Huang, and Q. Chen, "Transport of intensity equation: a tutorial," Opt. Lasers Eng., **106187** (2020).