

## Erratum to: Quantum Image Encryption Algorithm Based on Quantum Image XOR Operations

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The original version of this article unfortunately contained mistakes that were introduced during production processing. The introduced mistakes are listed and corrected below:

1. Eq. (7)

$$= \bigotimes_{i=0}^7 \left( T_{YX}^i \left| C_{YX}^i \right. \right) = \bigotimes_{i=0}^7 \left| C_{YX}^i \otimes h_{YX}^i \right\rangle = |f(Y, X)\rangle$$

should be

$$= \bigotimes_{i=0}^7 \left( T_{YX}^i \left| C_{YX}^i \right. \right) = \bigotimes_{i=0}^7 \left| C_{YX}^i \oplus h_{YX}^i \right\rangle = |f(Y, X)\rangle. \quad (7)$$

2. The sentence below Eq. (7), “UYX” should be “U<sub>YX</sub>”.

3. The last line in Eq. (9)

$$= \frac{1}{2^n} \left( \sum_{y=0}^{2^n-1} \sum_{\substack{x=0 \\ yx \neq YX}}^{2^n-1} \bigotimes_{i=0}^7 \left| C_{yx}^i \right. \right| yx \rangle + \bigotimes_{i=0}^7 \left| C_{YX}^i h_{YX}^i \right. \rangle | XY \rangle \right)$$

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The online version of the original article can be found at <http://dx.doi.org/10.1007/s10773-016-2954-6>.

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should be

$$= \frac{1}{2^n} \left( \sum_{y=0}^{2^n-1} \sum_{\substack{x=0 \\ yx \neq YX}}^{2^n-1} \otimes_{i=0}^7 \left| C_{yx}^i \right\rangle |yx\rangle + \otimes_{i=0}^7 \left| C_{YX}^i \oplus h_{YX}^i \right\rangle |YX\rangle \right). \tag{9}$$

4. Eq. (10)

$$\begin{aligned} B_{Y_1 X_1} B_{YX} |M\rangle &= B_{Y_1 X_1} \left( B_{YX} \frac{1}{2^n} \sum_{y=0}^{2^n-1} \sum_{y=0}^{2^n-1} \otimes_{i=0}^7 \left| C_{yx}^i \right\rangle |yx\rangle \right) \\ &= B_{Y_1 X_1} \frac{1}{2^n} \left( \sum_{y=0}^{2^n-1} \sum_{\substack{x=0 \\ yx \neq YX}}^{2^n-1} \otimes_{i=0}^7 \left| C_{yx}^i \right\rangle |yx\rangle + \otimes_{i=0}^7 \left| C_{YX}^i h_{YX}^i \right\rangle |YX\rangle \right) \\ &= \frac{1}{2^n} \left( \sum_{y=0}^{2^n-1} \sum_{\substack{x=0 \\ yx \neq YX, Y_1 X_1}}^{2^n-1} \otimes_{i=0}^7 \left| C_{yx}^i \right\rangle |yx\rangle + \otimes_{i=0}^7 \left| C_{YX}^i h_{YX}^i \right\rangle |YX\rangle + \otimes_{i=0}^7 \left| C_{Y_1 X_1}^i \otimes h_{Y_1 X_1}^i \right\rangle |Y_1 X_1\rangle \right) \end{aligned}$$

should be

$$\begin{aligned} B_{Y_1 X_1} B_{YX} |M\rangle &= B_{Y_1 X_1} \left( B_{YX} \frac{1}{2^n} \sum_{y=0}^{2^n-1} \sum_{x=0}^{2^n-1} \otimes_{i=0}^7 \left| C_{yx}^i \right\rangle |yx\rangle \right) \\ &= B_{Y_1 X_1} \frac{1}{2^n} \left( \sum_{y=0}^{2^n-1} \sum_{\substack{x=0 \\ yx \neq YX}}^{2^n-1} \otimes_{i=0}^7 \left| C_{yx}^i \right\rangle |yx\rangle + \otimes_{i=0}^7 \left| C_{YX}^i \oplus h_{YX}^i \right\rangle |YX\rangle \right) \\ &= \frac{1}{2^n} \left( \sum_{y=0}^{2^n-1} \sum_{\substack{x=0 \\ yx \neq YX, Y_1 X_1}}^{2^n-1} \otimes_{i=0}^7 \left| C_{yx}^i \right\rangle |yx\rangle + \otimes_{i=0}^7 \left| C_{YX}^i \oplus h_{YX}^i \right\rangle |YX\rangle + \otimes_{i=0}^7 \left| C_{Y_1 X_1}^i \oplus h_{Y_1 X_1}^i \right\rangle |Y_1 X_1\rangle \right). \tag{10} \end{aligned}$$

5. First line 1 below section 4.1 where it says,

$$|M\rangle = \frac{1}{2^n} \sum_{y=0}^{2^n-1} \sum_{y=0}^{2^n-1} |g(y, x)\rangle |yx\rangle$$

should be

$$|M\rangle = \frac{1}{2^n} \sum_{y=0}^{2^n-1} \sum_{x=0}^{2^n-1} |g(y, x)\rangle |yx\rangle.$$

The publisher regrets that the following errors were introduced during the production process.