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Corrections to “Linear Quantum State Observers”

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There are two mathematical mistakes in our article [1]. The first is the absence of a matrix transpose in our definition of the matrix $\boldsymbol{A}$ on page 5. The correct definition is

$$\boldsymbol{A} \triangleq -\imath(\boldsymbol{I}_d \otimes \boldsymbol{H} - \boldsymbol{H}^T \otimes \boldsymbol{I}_d).$$

The second mistake is the assumption that $\boldsymbol{H}$ is nondegenerate in Theorem 6. Beyond dimension $d = 2$, this assumption is not strong enough for the theorem to hold. The theorem remains true, however, if it is modified as follows.

Theorem 6: Let $\boldsymbol{H}$ be nondegenerate and 0 be the only repeated eigenvalue of $\mathcal{A}$. The closed quantum system $(\mathcal{A}, \mathcal{C})$ is observable if and only if the coherent quantum observability matrix $\mathcal{Q}_c(\mathcal{A}, \mathcal{C})$ has no zero columns and the incoherent quantum observability matrix $\mathcal{Q}_i(\mathcal{A}, \mathcal{C})$ has full column rank.

Proof: Regardless of the degeneracy of $\boldsymbol{H}$, Lemma 3 of [1] proves that $\mathcal{A}$ will have at least d zero eigenvalues. However, if $\boldsymbol{H}$ is nondegenerate, the same lemma proves that $\mathcal{A}$ has only d zero eigenvalues. The rest of the proof follows exactly as that published in [1]. □

The results of our article were summarized by Theorem 14 in the article’s conclusion. There, the assumption “When $\boldsymbol{H}$ is nondegenerate” should be replaced by “When $\boldsymbol{H}$ is nondegenerate and the only repeated eigenvalue of $\mathcal{A}$ is 0.”

REFERENCE

[1] M. Clouâtré, M. Balas, V. Gehlot, and J. Valasek, “Linear quantum state observers,” *IEEE Trans. Quantum Eng.*, vol. 3, 2022, Art. no. 5500515, doi: 10.1109/TQE.2022.3209927.