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Neural network technique for improving accuracy, reliability and robustness of beam position monitor system

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The beam position monitor (BPM) is a crucial instrumentation system for the commissioning and operation of the accelerator. The accuracy and robustness of the beam position monitor system are essential for ensuring the stability of the accelerator. Currently, the four voltage signals obtained by the BPM electrodes are used to calculate the beam position by fitting of a polynomial in BEPCII and HEPS. The system also provides a formula that expresses the relationship between the three voltage signals and the beam current position to improve the system's robustness. The existing polynomial fitting formula using four voltage signals has an optimal accuracy of only 10 μm, but the accuracy of the three voltage signals calculation is not high. To address this issue, we propose using neural networks for beam position calculation. This approach will not only guarantee the accuracy of the beam position measurement, but also improve the system's robustness, even in the case of one or two electrodes being wrong. In our experiments, the trained neural network has shown promising results, with an accuracy of less than 5 μm when using four voltage signals, less than 10 μm when using three voltage signals, and less than 15 μm when using two voltage signals. Therefore, our method can significantly improve the accuracy and the robustness of the system.

Footnotes

Funding Agency

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Yes

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