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Linear weight optimization of local magnetic field sensors for the integral field measurement in accelerator magnets

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The measurement of the integral magnetic field in accelerator magnets is crucial for the precise control and operation of particle accelerators. Traditional methods often rely on a fixed distribution of magnetic field sensors or long integral coils. Nonetheless, integral coils are sometimes unavailable in the magnet bore.

This study presents an approach to enhance integral magnetic field measurements through the linear weight optimization of local magnetic field sensors. Our methodology involves strategically placing and weighing sensors within the magnet to minimize errors between the measured and actual integral magnetic fields for different powering cycles. We employ optimization algorithms to determine the optimal linear combination of sensor readings that best approximates the integral field. This process improves measurement accuracy and reduces the number of required sensors.

We validate our approach through simulation and experimental setups. The results indicate that our optimized sensor placement and weighting scheme can be effectively implemented in existing accelerator systems, offering a scalable solution for enhancing particle accelerator performance.

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