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Estimation of beam transverse parameters through a multimode fiber using deep learning

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In response to CERN's need for alternative imaging solutions of scintillating screens due to the discontinuation of radiation-hardened VIDICON tubes, the single large-core multimode fiber (MMF) has been identified as a potential medium to transmit image signals to a CMOS camera situated away from radiation-prone areas. However, significant challenges in image distortion at the fiber's output end complicate the reconstruction of the original beam distribution.

To address this, a novel machine learning-based approach was introduced that utilizes a deep convolutional encoder-regressor network. It first compresses the fiber image into a latent space. Subsequently, a fully connected regression network directly estimates the beam parameters, such as centroids and widths, from the encoder output without the need to reconstruct the detailed image. This contribution will showcase an end-to-end system capable of estimating transverse beam parameters from the MMF output speckle patterns. Offering a safe, camera-preserving solution for beam imaging in high-radiation environments.

Footnotes

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