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Convolutional neural network for centrality determination in fixed target experiments

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Fixed target experiments have an unique possibility to measure centrality of colliding systems by hadronic calorimeters on the beam line. This is usually achieved by the detection of all forward nucleon spectators and accomplishes fluctuation and correlation measures with lower biases than in collider experiments. However, hadronic calorimeters have much lower resolution than multiplicity detectors that introduces additional volume fluctuation to the measures.
In this work, we present the first attempt to increase the resolution capacity of the spectator detector by implementing a convolutional neural network to the modular structure of the Projectile Spectator Calorimeter of the NA61/SHINE experiment. The data were generated in the framework of SHIELD Monte-Carlo event generator with detector response simulated with GEANT4 for the collisions of the lightest available system (^{7}Be+^{9}Be) and for the highest beam momentum (150A GeV/c). Two ways of determination centrality – by a number of forward spectators and by forward energy – are considered. In comparison with the classical centrality selection method, the neural net shows a significant increase of centrality selection accuracy after implementation.

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