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Machine learning applications on event reconstruction and identification for ISS-CREAM

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We explore applications of machine learning in particle astrophysics. A supervised machine learning algorithm is applied to the visual representations of the energy deposits in two orthogonal views of the calorimeter of ISS-CREAM. Convolutional Neural Networks (CNNs) backed by Tensorflow are used to calibrate the sampled energy of the calorimeter and reconstruct the total primary energy of cosmic rays (CR), as well as for CR identification. The CNN regression models are trained on detailed Monte Carlo simulated events reproducing the behavior of the ISS-CREAM instrument suite, and the results indicate that a calorimeter energy reconstruction resolution of as good as 20% is achieved. The energy sampled in the calorimeter is determined with a resolution as good as 10%. The CNN classification model can reach a CR identification accuracy of up to 93%. The results from machine learning methods are consistent with a simple scaling of the sampled energy. The increased accuracy of this CNN energy reconstruction comes from the additional information of the longitudinal and lateral energy deposit profiles. This machine learning approach is widely applicable to a range of particle physics and astrophysics problems.

Keywords

Machine learning; Energy reconstruction; Shower profile; Cosmic ray;

Collaboration

other Collaboration

Subcategory

Experimental Methods & Instrumentation

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