Research on the Method of Landform Feature Recognition based on Deep Learning

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***Abstract*—This research proposes a deep learning-based method for geomorphic feature recognition, aiming to achieve high-precision classification of complex geomorphic echo signals through deep learning techniques. First， a GAN-based geomorphic feature recognition model is established, incorporating a multi-layer fully connected discriminator and generator, optimized for generalization capability via adversarial training. To address the small-sample problem, an improved generative adversarial network is employed for data augmentation and feature alignment, generating typical geomorphic power spectra with echo characteristics. A three-layer neural network classification module is designed to identify different geomorphic types, while techniques such as cosine annealing, attention mechanisms, label smoothing, and global normalization are applied to mitigate overfitting and gradient oscillation. Finally, the adversarial capability of the proposed GAN is validated using a simulated dataset, with the data split into 7:3 training and testing sets to evaluate the model's classification performance. The results demonstrate that the proposed method achieves over 90% recognition accuracy for various geomorphic types on both simulated and real-world datasets, confirming the effectiveness of the GAN-based geomorphic feature recognition model.**

***Keyword*—Deep Learning , Generative Adversarial Network , Geomorphic Feature Recognition , Data Augmentation , Classification Accuracy**

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