Komparasi Kinerja Model Grey Wolf Optimization Support Vector Machine (GWO-SVM) dan Extreme Gradient Boosting (XGBoost) dalam Klasifikasi Intensitas Ledakan Batu pada Tambang Bawah Tanah = Model Performance Comparison of Grey Wolf Optimization Support Vector Machine (GWO-SVM) and Extreme Gradient Boosting (XGBoost) in Rockburst Intensity Classification in Underground Mines

Adhitya Dwi Nugraha, author

Abstrak

Ledakan batu merupakan kecelakaan destruktif yang cukup sering terjadi pada tambang bawah tanah. Seiring dengan berkembangnya teknologi, machine learning hadir sebagai alternatif solusi yang dapat dimanfaatkan dalam langkah preventif atas kasus ledakan batu. Penelitian ini menggunakan GWO-SVM dan XGBoost sebagai model machine learning dalam klasifikasi ledakan batu dan intensitasnya pada tambang bawah tanah. Grey Wolf Optimization (GWO) digunakan sebagai optimizer dari parameter SVM. Intensitas ledakan batu dibedakan atas tidak ada ledakan batu, lemah, sedang dan kuat. Dalam implementasi model, digunakan 467 kasus ledakan batu yang dikumpulkan dari berbagai sumber. Fitur yang digunakan pada penelitian ini meliputi tegangan maksimal tangensial, kekuatan tekan uniaksial, kekuatan tarik uniaksial, koefisien tegangan, koefisien kerapuhan batuan, dan indeks regangan elastis. Sebelum implementasi model dilakukan data preprocessing yang meliputi imputasi missing values, menghapus outlier, normalisasi fitur dan resampling data. Kinerja model dievaluasi berdasarkan nilai metrik accuracy, precision, recall, dan f1-score dengan memerhatikan running time dan proporsi data training berkisar dari 50% hingga 90%. Hasil penelitian menunjukkan bahwa GWO-SVM mengungguli XGBoost baik dalam klasifikasi ledakan batu dengan accuracy 98.0392%, precision 97.8495%, recall 98.2609%, dan f1-score 98.0161% serta klasifikasi intensitas ledakannya dengan accuracy 75.8242%, precision 75.1473%, recall 75.3115%, dan f1-score 75.2150%.

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Rockburst is a destructive accident that frequently occurs in underground mines. With the advancement of technology, machine learning has emerged as an alternative solution that can be utilized to measures against rockbursts. This research employs GWO-SVM and XGBoost as machine learning models for the classification of rockburst and its intensity in underground mines. Grey Wolf Optimization (GWO) is used as an optimizer for SVM parameters. The intensity of a rockburst is classified into four categories: no rockburst, weak, moderate, and strong. The implementation of the model utilizes 476 cases of rockburst collected from various sources. The features used in this study include maximum tangential stress, uniaxial compressive strength, uniaxial tensile strength, stress coefficient, rock brittleness coefficient, and elastic strain index. Before implementing the model, data preprocessing is conducted, which includes imputing missing values, removing outliers, feature normalization, and data resampling. The performance of the model is evaluated based on metrics such as accuracy, precision, recall, and f1-score with various training data proportions ranging from 50% to 90%. The research results indicate that GWO-SVM outperforms

XGBoost in both the classification of rockburst with 98.0392% accuracy, 97.8495% precision, 98.2609% recall, and 98.0161% f1-score as well as intensity with 75.8242% accuracy, 75.1473% precision, 75.3115% recall, and 75.2150% f1-score.