

ABSTRAK

KLASIFIKASI SPEKTRUM LISTRIK CORONA DISCHARGE MENGUNAKAN METODE *CRNN (CNN-LSTM)* BERDASARKAN WARNA (RGB)

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Kegagalan isolasi pada peralatan bertegangan tinggi akibat *partial discharge*, khususnya *corona discharge*, dapat mengakibatkan kerusakan yang parah jika tidak dideteksi sejak dini. Metode pemantauan konvensional 1D (seperti sensor akustik dan frekuensi radio) seringkali mengalami kegagalan deteksi akibat tingginya interferensi derau (*noise*) latar belakang. Penelitian ini mengusulkan sebuah pendekatan mutakhir (state-of-the-art) untuk mengklasifikasikan tiga jenis *partial discharge* (*corona*, *internal*, dan *superficial*) menggunakan informasi warna dari citra *Phase Resolved Partial Discharge (PRPD)*. Metode yang digunakan adalah arsitektur *deep learning* hibrida *Convolutional Recurrent Neural Network (CRNN)*. Citra berformat RGBA dikonversi menjadi RGB, disegmentasi ke dalam ruang warna *HSV*, dan diekstraksi fitur kepadatan warnanya menggunakan histogram *Hue* dan *Saturation*. Arsitektur *CRNN* yang dibangun memanfaatkan lapisan *Convolutional Neural Network (CNN)* untuk mengekstraksi representasi fitur spasial dua dimensi, yang secara sekuensial diteruskan ke lapisan *Long Short-Term Memory (LSTM)* untuk merekam dependensi temporal sinyal. Penelitian ini menggunakan dataset sebanyak citra, dan dievaluasi menggunakan metode *Cross-Industry Standard Process for Data Mining (CRISP-DM)*. Hasil pengujian pada 142 data uji menunjukkan bahwa model *CRNN* memiliki performa diagnostik yang luar biasa dengan capaian nilai *accuracy*, *precision*, *recall*, dan *F1-score* masing-masing sebesar 1,00 (100%), dengan konvergensi *loss* yang rendah pada angka $\sim 0,0192$ di *epoch* 50. Hal ini membuktikan bahwa ekstraksi fitur kolorimetri RGB yang dikolaborasikan dengan metode *CRNN* sangat efektif dan kebal terhadap *false noise* dalam mengidentifikasi pola spektrum listrik *corona discharge*.

Kata Kunci: *Corona Discharge, Partial Discharge, RGB, CRNN, Deep Learning, Spektrogram, CRISP-DM.*

ABSTRACT

CLASSIFICATION OF CORONA DISCHARGE ELECTRICAL SPECTRUM USING CRNN (CNN-LSTM) METHOD BASED ON COLOR (RGB)

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Insulation failure in high-voltage equipment caused by partial discharge, specifically corona discharge, can lead to severe damage if not detected early. Conventional 1D monitoring methods (such as acoustic and radio frequency sensors) often fail to detect faults due to high background noise interference. This study proposes a state-of-the-art approach to classifying three types of partial discharge (corona, internal, and superficial) utilizing color information from Phase Resolved Partial Discharge (PRPD) images. The proposed method employs a hybrid deep learning architecture, the Convolutional Recurrent Neural Network (CRNN). RGBA formatted images were converted to RGB, segmented into the HSV color space, and their color density features were extracted using Hue and Saturation histograms. The constructed CRNN architecture leverages Convolutional Neural Network (CNN) layers to extract two-dimensional spatial feature representations, which are sequentially passed to Long Short-Term Memory (LSTM) layers to record the signal's temporal dependencies. This study utilized a dataset of images and was evaluated using the Cross-Industry Standard Process for Data Mining (CRISP-DM) methodology. Test results on 142 test data demonstrate that the CRNN model achieves an outstanding diagnostic performance, reaching 1.00 (100%) in accuracy, precision, recall, and F1-score, with a low loss convergence of ~ 0.0192 at epoch 50. These results prove that RGB colorimetry feature extraction in collaboration with the CRNN method is highly effective and immune to false noise in identifying corona discharge electrical spectrum patterns.

Keywords: Corona Discharge, Partial Discharge, RGB, CRNN, Deep Learning, Spectrogram, CRISP-DM.