Machine Learning-Assisted Optical Diagnostics for Characterization of an Atmospheric Pressure Surface Dielectric-Barrier Discharge

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Recently, the integration of machine learning (ML) into the field of plasma physics and relevant technologies has marked notable progress [1]. The coupling of powerful ML algorithms with simple conventional optical methods can shed light on various plasma features, enabling thus the control of plasma-based processes even in real time.

Accordingly, in this work, routine non-intrusive optical diagnostics assisted by unsupervised and supervised ML algorithms were used for the characterization of atmospheric pressure plasmas [2]. Unsupervised principal component analysis (PCA) was applied to optical emission spectroscopy (OES) and charge-coupled device (CCD) imaging data originated from a cylindrical surface dielectric-barrier discharge (sDBD) [2,3]. This allowed to distinguish the discharge operating modes in terms of the waveform (AC or DC pulsed) as well as the amplitude of the driving high voltage. Furthermore, using the OES data, a predictive model based on multilayer perceptron (MLP) neural networks was constructed with respect to the driving voltage amplitude. Finally, PCA analysis of OES data acquired around the cylindrical surface of the DBD (0o, 90o, 180o, and 270o side views) was useful to assess the discharge pattern and homogeneity. By reducing the dimensionality of the OES data via PCA and feeding it to the MLP, it was discovered that the neural network model could accurately predict the applied voltage with very low error, achieving R2 values of up to 99% for the regression of the data.

References

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