The application of multivariate analysis tools for non-invasive performance analysis of atmospheric pressure plasma

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This paper describes the development and use of real-time non-invasive Multivariate analysis tools for the performance monitoring of atmospheric pressure plasma. The MVA tools (acoustic spectrogram analysis, principal component analysis and non-parametric analysis) are embedded within a LabVIEW software program. The software program is used to probe a parallel-plate atmospheric pressure process system. It is found that the acoustic frequency spectrum distribution provides a signature of the plasma mode of operation. The signatures are modeled as overtones of the fundamental drive frequency and combination signals (intermodulation distortion). Within these spectrums syncopated patterns are observed. The acoustic signatures are correlated with changing electrical parameters. Using appropriate scaling factors, PCA of the current and voltage waveform are used to generate data set clusters that are deterministic of the acoustic signals. Non-parametric cluster analysis is used to identify and classify the modes.

Keywords: Multivariate analysis, frequency analysis, principal component analysis, and non-parametric cluster analysis, atmospheric pressure plasma, acoustic emission and electrical waveform identification.