

Automated and Quicker Processing Platform (*iECAna*) for Large-Scale Electrochemical Data with ML-Based Modeling: Next-Gen Corrosion Analysis and Diagnostic Application

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In recent years, rapid developments in electrochemical diagnostic methods, including corrosion analysis and biosensor assays, have led to the generation of large, complex datasets that surpass the practical limits of manual processing. This has accentuated the need for a tool capable of rapidly analyzing large volumes of potentiostat output files, such as the DTA, in an accurate and reproducible manner.

This work presents an innovative software development and desktop application (*iECAna*) that streamlines the processing and interpretation of substantial quantities of raw potentiostat data. The software allows users to analyze hundreds of experiments in seconds by extracting key electrochemical parameters and exporting results to Excel for further evaluation. The platform also contains an option to integrate and instantly train a customized machine-learning model to expedite workflows utilizing Support Vector Machines and neural-network architectures.

The software was validated on Electrochemical Impedance Spectroscopy (EIS) and Cyclic Voltammetry (CV) biosensor data from a protein calibration assay on the protein MMP-12, a biomarker with potential use in post-stroke analysis. The software produced results within a 5% margin of error when compared to traditional electrochemical analysis (Gamry Echem Analyst's Constant Phase Element fit) and manual CV interpretation, while the processing time has been significantly reduced, (typically spending 3 hours to 10 seconds). This demonstrates the practical value that this software has in high-volume electrochemical research through data-driven interpretation of potentiostat measurements. This new platform will have potential application for the Next-Gen corrosion analysis and Diagnostic tools in healthcare industry.