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1P33 - Advanced optimization and machine learning for magnetron design

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High-power microwave source design has evolved from analytic scaling laws to advanced computational methods that can virtually prototype devices before metal is cut in the laboratory. However, with this success has come the requirement that the DOD have the capability to quickly design novel HPM sources for applications with different power and frequency requirements. This need for rapid design capability has pushed both optimization and machine learning techniques into the field of high power RF sources.
We perform 2D simulations of the Rising Sun magnetron using kinetic modeling framework VSim and optimization engine Dakota. We simulate operation of the magnetron in a series of conditions as a part of the optimization study with the goal to identify the optimum device geometry that operates in a specified frequency bandwidth and at the same time produces adequate output power. We investigate a broad spectrum of control parameters, multiple optimization formulations and a combination of linear and non-linear constraints to fully describe magnetron's physical state of operation. Furthermore, we apply machine learning techniques to investigate modes of operation of the magnetron with optimized geometry, to efficiently navigate through the physical parameters space, predict and mitigate its performance.

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