In general, the operating characteristics of RF vacuum electronic or plasma devices are affected by the power supply, e.g., a pushing effect on the oscillating frequency of a magnetron by a supplied anode current. The external impedance connected to the system under study should be included in the electromagnetic (EM) particle-in-cell (PIC) simulations especially when the system is in a transient state or characterized with a dynamic impedance. In this work, an algorithm for coupling external circuit elements to EM PIC simulations is developed. The circuit equation including an external voltage \( V \), or current source \( I \), resistance \( R \), inductance \( L \), capacitance \( C \), and the dynamic load (I-V) is solved simultaneously with the EM PIC updaters through an instant measured voltage \( V \) across the system to obtain the supplied current \( I \) for feeding into the system. This external circuit model is under testing and will be implemented in a 3D conformal finite-difference time-domain PIC code, VORPAL.


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