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A 2-D Numerical Model for the Estimation of the Time Varying Inductance of an Explosively-Driven Helical Flux Compression Generator

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There is a considerable interest worldwide in the development of compact and single-shot expendable pulsed power sources for various applications. Explosively-driven helical magnetic flux compression generators (HFCGs) are natural contenders to provide the high power requirement for such applications. They consist of a hollow cylindrical metal tube called the armature filled with high energy explosives, placed within a helical coil that forms the stator. The explosives when detonated cause the armature to expand leading to the compression of the magnetic flux present within the space between the armature and the stator. This flux is initially set up by the seed current flowing in the circuit using a separate current source. These can be used to achieve very high magnetic fields accompanied with very high currents.
The present interest in the use of HFCGs brings about the need for a fast computer code for use in the preliminary design stage which can provide results with good accuracy. Using these codes, the performance of the generator can be analyzed before conducting actual experiments, which are difficult to conduct. The electrical equivalent circuit of HFCG can be represented by a first-order series R-L circuit with time-varying elements. During armature expansion, equivalent resistance and inductance of the generator tend to vary with time and geometry. A 2-D numerical model described in this paper presents an approach to evaluate the time-varying inductance of the generator by simulating the chemical explosion occurring within the armature using a commercially available package (AUTODYN) and using these results, a numerical code has been developed to model the time-varying inductance of the generator. The results obtained using the numerical model are compared with the ones available in the literature to validate the code developed. The results will be presented and discussed in detail in the final manuscript.

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