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Electromagnetic Modeling of a MESFET Transistor Using the Moments Method Combined with Generalised Equivalent Circuit Method

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Abstract : The communications' and radar systems' demands give rise to new developments in the domain of active integrated antennas (AIA) and arrays. The main advantages of AIA arrays are the simplicity of fabrication, low cost of manufacturing, and the combination between free space power and the scanner without a phase shifter. The integrated active antenna modeling is the coupling between the electromagnetic model and the transport model that will be affected in the high frequencies. Global modeling of active circuits is important for simulating EM coupling, interaction between active devices and the EM waves, and the effects of EM radiation on active and passive components. The current review focuses on the modeling of the active element which is a MESFET transistor immersed in a rectangular waveguide. The proposed EM analysis is based on the Method of Moments combined with the Generalised Equivalent Circuit method (MOM-GEC). The Method of Moments which is the most common and powerful software as numerical techniques have been used in resolving the electromagnetic problems. In the class of numerical techniques, MOM is the dominant technique in solving of Maxwell and Transport's integral equations for an active integrated antenna. In this situation, the equivalent circuit is introduced to the development of an integral method formulation based on the transposition of field problems in a Generalised equivalent circuit that is simpler to treat. The method of Generalised Equivalent Circuit (MGEC) was suggested in order to represent integral equations circuits that describe the unknown electromagnetic boundary conditions. The equivalent circuit presents a true electric image of the studied structures for describing the discontinuity and its environment. The aim of our developed method is to investigate the antenna parameters such as the input impedance and the current density distribution and the electric field distribution. In this work, we propose a global EM modeling of the MESFET AsGa transistor using an integral method. We will begin by describing the modeling structure that allows defining an equivalent EM scheme translating the electromagnetic equations considered. Secondly, the projection of these equations on common-type test functions leads to a linear matrix equation where the unknown variable represents the amplitudes of the current density. Solving this equation resulted in providing the input impedance, the distribution of the current density and the electric field distribution. From electromagnetic calculations, we were able to present the convergence of input impedance for different test function number as a function of the guide mode numbers. This paper presents a pilot study to find the answer to map out the variation of the existing current evaluated by the MOM-GEC. The essential improvement of our method is reducing computing time and memory requirements in order to provide a sufficient global model of the MESFET transistor.

Keywords : active integrated antenna, current density, input impedance, MESFET transistor, MOM-GEC method
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