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Time-Dependent Transport in Carbon Nanotube Transistors[1]
YUPENG CHEN, University of Central Florida, JING GUO, University of Florida, THOMAS WU, University of Central Florida — Recently, very high frequency properties of carbon nanotube field-effect transistors (FETs) are attracting extensive research interests due to their high mobility and near ballistic transport [1 – 4]. To explore the performance limit of CNTFETs for very high frequency applications, it is important to understand time-dependent transport in CNTFETs. Self-consistent, quasi-static quantum simulations have been applied to assess the high-frequency performance [4]. However, the validity of quasi-static approximation needs to be examined. In addition, a full-time dependent simulation is necessary to examine some very important characteristics, such as frequency-dependent conductance. Our study on AC characteristics of CNTFETs is based on solving a full time-dependent quantum transport equation for CNTFETs using the finite difference time domain (FDTD) method for the first time. The dependence of small signal transconductance and gate capacitance on the frequency of the applied bias is examined. The intrinsic cut-off frequency, a device metric important for radio-frequency (RF) applications, and the intrinsic switching time, a metric important for digital switch applications, are computed using the full time-dependent simulations. The validity of the widely used quasi-static approximation is examined.

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