Modelling and Characterization of GaAs MESFET

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The development of low noise amplifiers and receivers for communication components that can operate also at high frequencies and present decreasing geometric sizes, the field effect transistors are the solution. The FETs modeling is one of the preoccupations of certain researchers to understand some phenomenon of this component. Our work consists essentially of improving the implementation of an analytical model called PHS (Pucel, Hauss and statz).

This model allows us to describe the variation of the basic elements of the equivalent schema in small signal with the gate and drain voltage using different simplified hypotheses. To produce the characteristics evolution, we need introduce the first region's length. For this, we have brought a personnel idea based on the discretization of the channel and establish a test to define the channel's pinching.

To validate the model we performed a simulation which permitted us to obtain the principal functional characteristics of the MESFET as the variation of the drain currant versus the drain voltage for several values of the gate voltage. We notice that, the current is linear with the drain source voltage until the saturation value, where it becomes steady. So we have two areas: linear and saturation. We obtained the current's maximum for null value of the gate source voltage.

-The trans-conductance increases with the diminution of the gate source voltage.

-The conductance decreases with the augmentation of the drain voltage. Its maximum is in the linear region.

-The capacitance is in the fF class. It becomes almost steady for important absolutes values of the gate voltage.

To validate these results we have conducted two kinds of comparison: The first one is a comparison with a reference model. We observe that the results are nearly similar. The second comparison is done with the experiment. So that the curves are comparable. We notice a significant divergence, which can be attributed to the different approximations of the model. In conclusion, we can say that the obtained results are in agreement with the MESFETs general theory. Nevertheless, there are a few divergences.

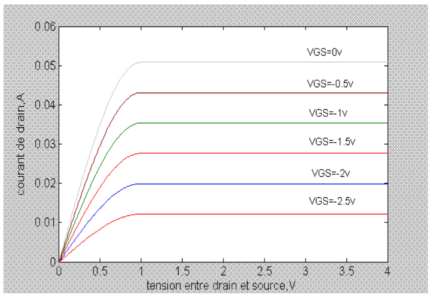

Fig.1: Characteristics $I_D(V_{GS}, V_{DS})$ using the PHS model.

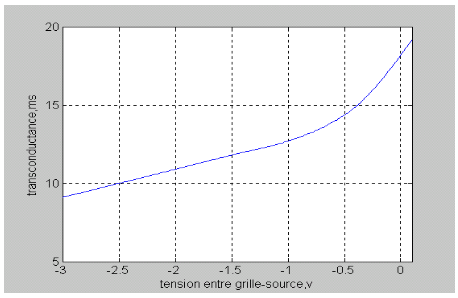

Fig.2: Transconductance variation versus V_{GS} using PHS model.

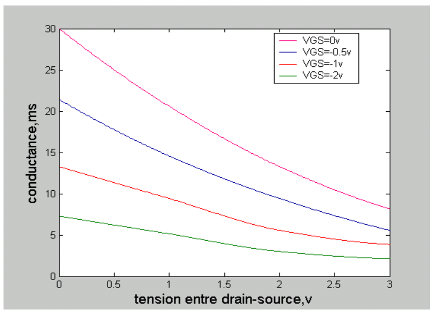

Fig.3: Conductance variation versus V_{DS} using PHS model.

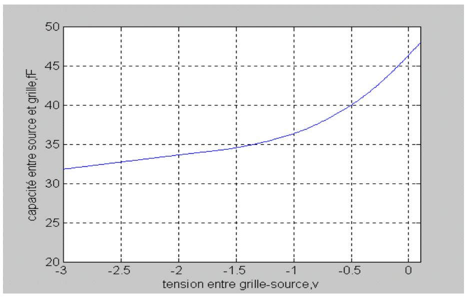

Fig.4: Gate source capacitance calculated using PHS model.

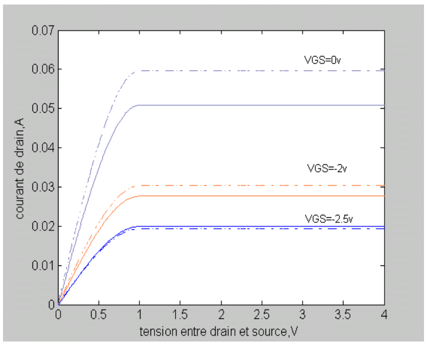

Fig.5: Comparison reference model– PHS model (point-:reference model, continue: PHS model).

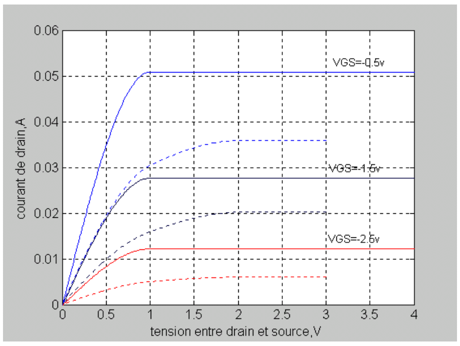

Fig.6: Comparison PHS model-experience (points: experience, continue: PHS model).