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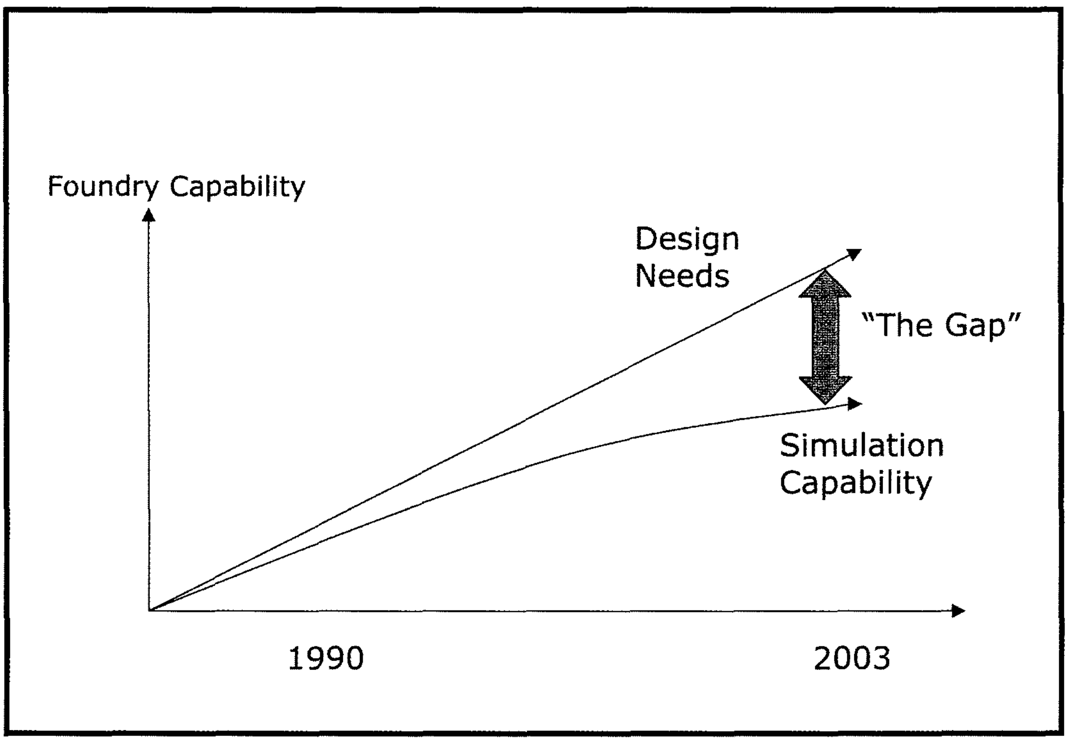
As devices such as HEMTs play a role in ever increasingly complex practical RF applications, finding a way to shorten the path to correct devices and circuit designs is of growing importance. One preferred solution is to unlock the value of simulation power to get closer to first time design success goals.

Dynamic measurement and analysis for accurate models

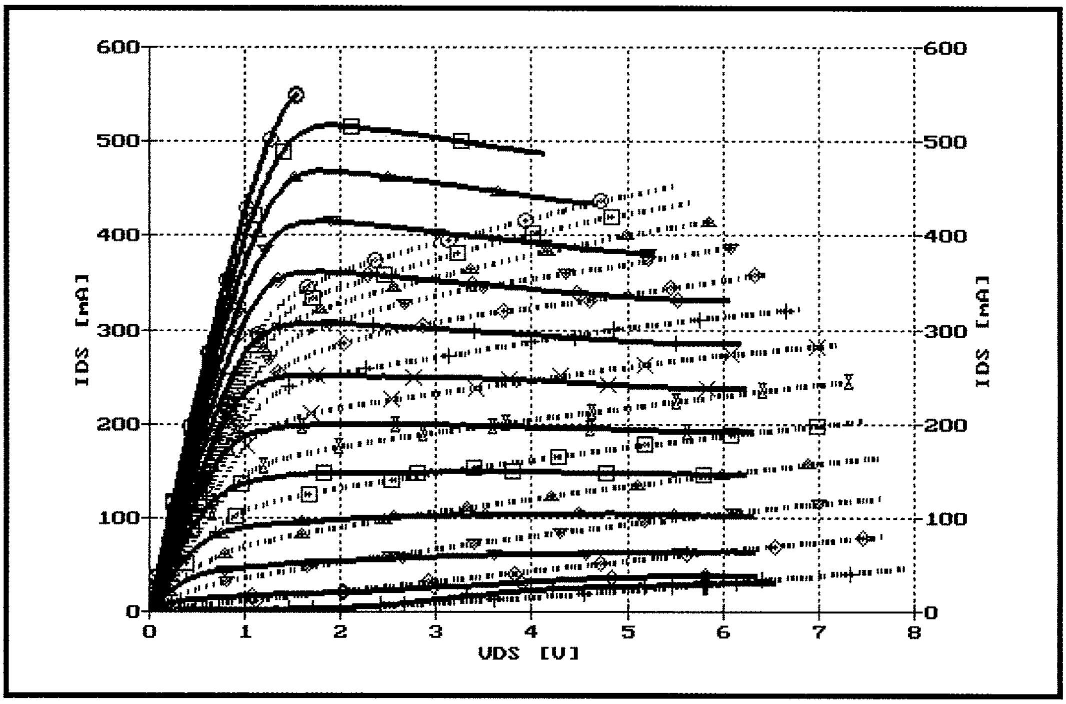
The need for better device models is driven by the ever-increasing need for high fidelity simulations of increasingly complex systems. The drive for higher complexity, lower cost and faster time to market has run into a gap between the need and the ability to simulate. A large part of that gap is due to inaccurate device models leading to a typically high number of design iterations during R&D.

Resulting designs also have to include "margin" to cover unknowns and margin costs money. In addition, what is really possible with a given process may never be fully realised because designer cannot explore the full design space: only that part allowed for by current models and modelling technology. Dynamic I-V Analysis (DiVA) can help provide answers and breakthroughs in this area.

A common experience is that designers may only simulate to a certain degree before prototyping if they believe that further attempts at higher fidelity results will either fail or produce inconsistent or unpredictable returns. This means that today's complex designs are often finished in a sub-optimal way because of time constraints and because prototyping cannot allow enough freedom (often due to time and cost constraints) to explore the design space for better options.
As a consequence there is a gap between what a designer could and should design with a given



Design Gap



MESFET with Self Heating and Traps Static (bold lines) and dynamic (broken lines) characteristics measured about 5.8V, 25mA

technology and what he is able to actually achieve, given current simulation capability.

However, it does appear that, despite significant issues, designers still use EDA products because they do need to simulate their designs. But the gap has been growing between fab capability and design/simulation capability. Simulators provide value in supporting design choice, but are generally seen as unreliable or insufficient.

How can we help improve things? It would be entirely logical for designers to focus only on areas that allow them to get more value from simulation products, if they see value for their investment. Value is closely tied to accuracy of results, as measured by design iterations saved. In other words, value is increased as the Gap is closed.

In the case of circuit simulators: value = ability to achieve accurate results, in a reasonable time for an acceptable investment. So how will simulation products deliver more inherent value in the future? How will they close the Gap?

Taking each of the above points in turn:

- Reasonable Time

Improving 'Time to result' is the focus of continuing investment. Simulators are already in the 'fast enough' region for tackling the level of problems that designers are comfortable submitting. More simulations don't always produce better results; faster simulators don't really close the Gap. Making things faster and cheaper is a given, but neither of these really helps when it comes to closing the Gap.

- Acceptable Investment:

Simulation Software will always cost too much! Paying more won't ensure the Gap is closed.

- Accurate Results:

The only area where there is real scope to close the Gap is fundamental accuracy. Fundamental accuracy is the dominant variable in establishing simulation value, because slower software that gets you there first time is always going to beat faster but inaccurate tools for a return on investment in businesses, where the cost of a design turn in lost revenue is so high. Improved accuracy will help close the Gap.

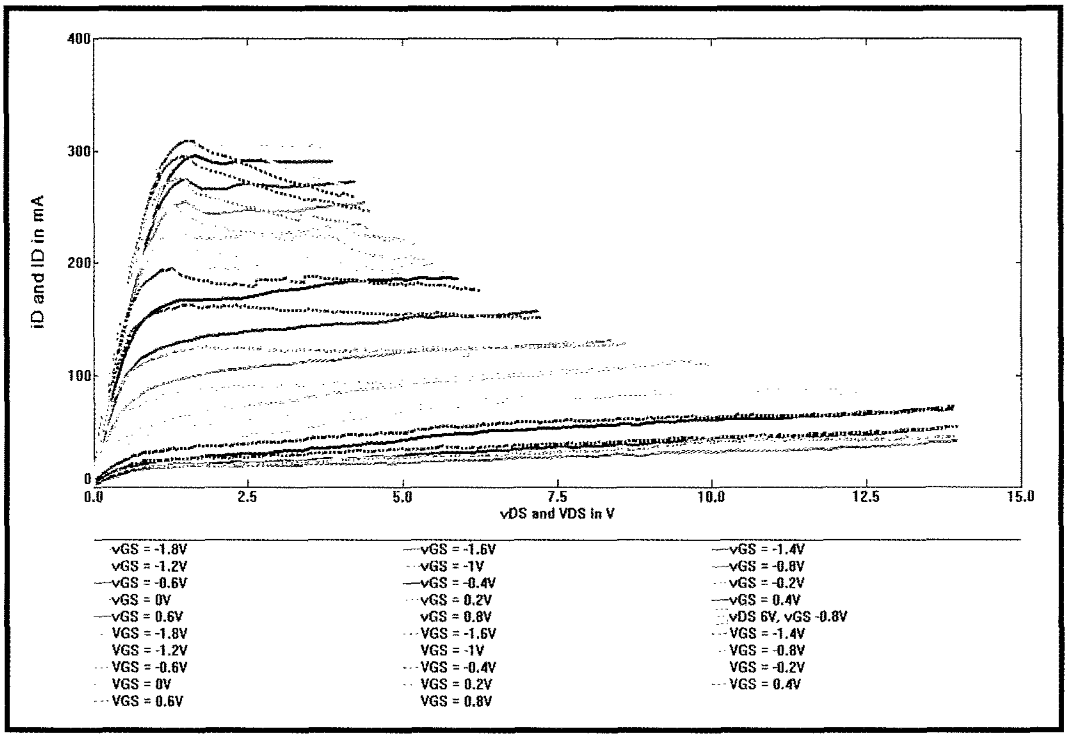
We now are in a position to see where we can practically invest in order to close the gap. Of these factors, coding accuracy is in the hands of the person who implements a model in the simulation tool. This is often the simulator vendor but it can also be an end user.

If Fundamental Simulation Accuracy = Engine Accuracy * Model Accuracy

Given that the best simulation engines in the industry are mature/accurate/stable within the constraints of their fundamental approach, that leaves Model Accuracy as the primary driver of simulation accuracy. Focusing on the world of semiconductor device models:

Model Accuracy = Model Type * Coding Accuracy * Extraction Methodology * Measurement Accuracy

Pulse versus Static IV Measurement of 600um pHEMT

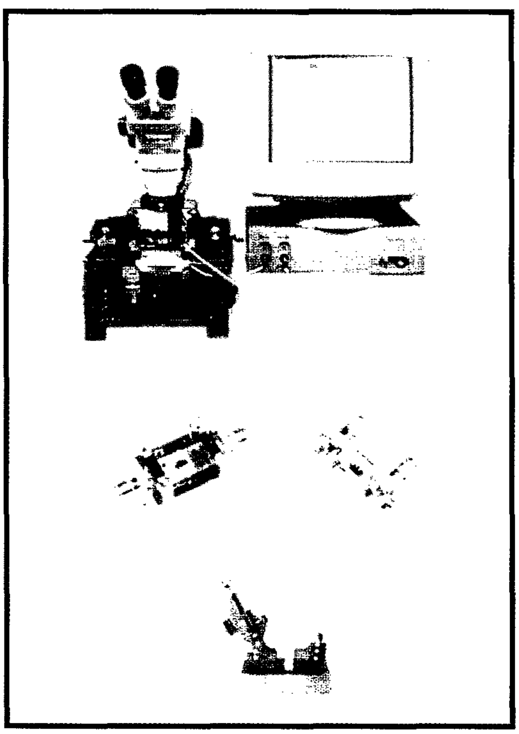


This is an area that demands quality control and good programming methods, but is not truly a primary variable. The three remaining areas do require consideration in improving simulation accuracy, and as such they all require investment. These are fast-pulsed current-voltage measurements performed around any chosen bias point of the device under consideration.

A useful way to think of dynamic I-V measurements is as a much more useful replacement of DC I-V measurement. This suggests that DC I-V measurements have significant limitations, which is indeed true as DC measurements only show how a device reacts to slow, low frequency changes in the terminal voltages.

Model type - selection/development.
Extraction methodology - how to turn measured data into model parameters.
Measurement accuracy - and suitability.
Investing here will help close the Gap.

Of these three areas, the common link is dynamic measurement and analysis



Dynamic I-V measurements use short pulses to avoid changes in deep-level trap occupancies and self-heating. Diva is able to showl true high-freqency device responses. Such measurements are particularly important for compound material systems which have medium or high levels of deep-level traps. This includes GaAs, InP, SiC and GaN based technologies.

Usually, what we are more interested in is how a device responds to fast, high frequency changes in the terminal voltages. This is exactly what dynamic I-V measurements provide.

This high-frequency information is much more useful for guiding process development and device design, and for developing circuit models used in circuit simulators.

Given that Dynamic IV shows these benefits, investing in this technique should have the affect of investing in precisely the areas that will help provide more accurate models and therefore help to Close the Gap.

For further information contact:
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