

4.4.: CREATING SYNTHETIC MEASUREMENT DATA FOR THE VERIFICATION OF EXTRACTION METHODS

Using IC-CAP for the extraction of model parameters offers a lot of flexibility in terms of creating user-defined models and implementing the corresponding extraction routines.

But when developing a new extraction strategy, we may run into two major problems:

- do the routines extract the parameters correctly?**
- and
- is the model able to fit the measured device at all?**

For the first problem: Assume that know the precise parameter values in advance. If we were able to generate quasi-measured data out of these parameters, then the extracted parameters would have to provide exactly these parameters back again!

Using IC-CAP, it is simple to perform such a check. The trick is to 'synthesize' quasi-measured data out of a set of parameters and to apply then the extraction routines to these data. This can be done as follows:

1. Define a measurement setup in IC-CAP, for which the extraction routines shall be tested. Example: an output characteristic for an Early-voltage extraction.
2. Select a 'typical' set of parameters (no default values like 'zero' or 'infinite', but instead real realistic values!)
3. Change the 'Output' data type to 'S' (simulated only). The array behind that output is no longer one-dimensional, i.e. measurement data any more, but only simulation data.
4. Simulate this setups using these parameter values.
5. Change the 'Output' data type back to type 'B'.
IC-CAP doubles now the data field to measurement and simulation data. Thus the simulated data of step 4. is now converted to measured data!
6. Reset the model parameters by clicking 'Reset to Defaults' and simulate the setup using the default parameters.
7. Apply the extraction routine-under-test and check the quality of the extracted parameters.

Provided we get the parameter values back within a good tolerance, we can be sure that the extraction works correctly. If we now apply the extraction to real-world measured data, we should obtain the right parameters. This is true if the measured data have the same shape like the model equations! If not, we might have to choose another model or go for subcircuit modeling.

And this leads us to the second part of this chapter

The problem of whether the DUT can even be described by a selected model can be checked by using the previously described method of 'direct, visual parameter extraction'. If this method does not produce a parameter plateau, the DUT does not behave in the manner described by the model! For an example, refer to fig. 1b and fig.1c below. The Gummel-Poon plot in fig. 1a shows no explicit recombination effect for i_B . However, this is precisely the effect described by the parameters ISE and NE! Therefore, there is no flat range visible in fig. 1b and 1c! Result: for that particular transistor, a simplified Gummel-Poon model without the base current recombination effect would be sufficient. On the other hand, if , for MOS transistors, the threshold voltage versus geometry shows a certain dependency and if the MOS model parameter V_{TH} would be a constant parameter independent of geometries, one could develop an improved MOS model by replacing that constant parameter V_{TH} by a function of $V_{TH} = f(L,W)$, where L and W are the length and width of the MOS transistor.

By the way, this is how company-internal models are developed and improved.

