Qucs: Quite Universal Circuit Simulator

Qucs is a GPL integrated Circuit Simulator developed by an international group of scientists and engineers [1].

• Qucs has a graphical user interface (GUI), based on Qt by Trolltech[3].
• Qucs uses a device model database that provides analog and mixed-signal device simulators.
• Qucs includes a device model and subcircuit library manager.

HICUM is a semi-physical compact bipolar transistor model [10]. Semi-physical means that for certain high-speed applications, some physical effects are discarded.

References:

GNU Simulators Supporting
Verilog-A Compact Model Standardization
Stefan Jahn1, Mike Brinson2, Michael Margraf3, Hélène Parruite4, Bertrand Ardouin5, Paolo Nenzi6, Laurent Lemaitre7

To understand how HICUM works internally, ADMS is interfaced to Qucs allowing Verilog-A compact device modelling.

ADMS is an open-source tool [7] that supports and simplifies compact model development, implementation, distribution, maintenance, and sharing. adms is a code generator that converts electrical compact model devices specified in high-level description languages into code compatible for the API of space simulators. Based on transformations specified in an xml format adms translates Verilog-AMS code into other target languages. The intended audience is people in universities or CAS companies interested in contributing to the development and improvement of the tool. Qucs also helps people whose main interest is using the tool to get a better understanding of how ADMS works internally. ADMS is available on SourceForge.net, one of the most popular open source software development web sites.

Qucs is available for the GNU/Linux, FreeBSD, Solaris, MacOS, Windows.

Qucs also provides interactive routines for the design of 1- and 2-port power amplifiers.

Qucs includes a device model and subcircuit library manager, and interactive routines for the design of 1- and 2-port power amplifiers.

ADMS data flow diagram

The ADMS-XML Interfaces

ADMS is a general purpose circuit simulator program. It implements three classes of analysis:

• Nonlinear DC analyses.
• Nonlinear Transient analyses.
• Linear AC analyses.

Qucs XML interface

Qucs includes a device model and subcircuit library manager.

Qucs is equipped with stand alone software tools for model synthesis, comparison, and simulation data post-processing using equations.

• analoguefunction.xml: this is used to create analogue function code
• qucsMODULEgui.xml: this generates a model GUI interface
• qucsMODULEdefs.xml: this creates device parameter descriptions

ADMS is interfaced to Qucs allowing Verilog-A compact device modelling.

Qucs is equipped with stand-alone software tools for model synthesis, comparison, and simulation data post-processing using equations.

Qucs is equipped with stand-alone software tools for model synthesis, comparison, and simulation data post-processing using equations.

Fig. 4: (a) Large-signal HICUM/Level2 equivalent circuit. (b) Thermal network used for self-heating calculation.

The important physical and electrical effects taken into account by HICUM/L2 are briefly summarized below:

• thermal dependences and self-heating
• weak avalanche breakdown of the base-collector junction
• parasitic substrate transistor
• bandgap differences (occurring in HBTs)
• lateral (geometry) scalability
• parasitic substrate transistor
• bandgap differences (occurring in HBTs)
• lateral (geometry) scalability
• parasitic substrate transistor
• bandgap differences (occurring in HBTs)
• lateral (geometry) scalability

The NGSpice XML interface

Qucs is equipped with stand-alone software tools for model synthesis, comparison, and simulation data post-processing using equations.

• Spice noise analysis is not (yet) supported.

Qucs is equipped with stand-alone software tools for model synthesis, comparison, and simulation data post-processing using equations.

Table 1: Qucs and NGSpice simulation results comparison. Note: numerical compatibility of the simulated base current.

<table>
<thead>
<tr>
<th>Vbe [V]</th>
<th>Ic (NGSpice) [A]</th>
<th>Ic (Qucs) [A]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>4.35E-12</td>
<td>4.35E-12</td>
</tr>
<tr>
<td>0.43</td>
<td>6.23E-12</td>
<td>6.23E-12</td>
</tr>
<tr>
<td>0.44</td>
<td>7.23E-12</td>
<td>7.23E-12</td>
</tr>
<tr>
<td>0.45</td>
<td>9.21E-12</td>
<td>9.21E-12</td>
</tr>
<tr>
<td>0.46</td>
<td>1.17E-12</td>
<td>1.17E-12</td>
</tr>
<tr>
<td>0.47</td>
<td>1.51E-12</td>
<td>1.51E-12</td>
</tr>
<tr>
<td>0.48</td>
<td>1.71E-12</td>
<td>1.71E-12</td>
</tr>
<tr>
<td>0.49</td>
<td>2.25E-12</td>
<td>2.25E-12</td>
</tr>
<tr>
<td>0.50</td>
<td>2.87E-12</td>
<td>2.87E-12</td>
</tr>
<tr>
<td>0.52</td>
<td>3.99E-12</td>
<td>3.99E-12</td>
</tr>
<tr>
<td>0.53</td>
<td>5.39E-12</td>
<td>5.39E-12</td>
</tr>
<tr>
<td>0.54</td>
<td>7.93E-12</td>
<td>7.93E-12</td>
</tr>
<tr>
<td>0.55</td>
<td>1.02E-11</td>
<td>1.02E-11</td>
</tr>
<tr>
<td>0.56</td>
<td>1.25E-11</td>
<td>1.25E-11</td>
</tr>
<tr>
<td>0.57</td>
<td>1.49E-11</td>
<td>1.49E-11</td>
</tr>
<tr>
<td>0.58</td>
<td>1.78E-11</td>
<td>1.78E-11</td>
</tr>
<tr>
<td>0.59</td>
<td>2.15E-11</td>
<td>2.15E-11</td>
</tr>
<tr>
<td>0.60</td>
<td>2.57E-11</td>
<td>2.57E-11</td>
</tr>
</tbody>
</table>

Fig. 5: NGSpice and gSchem running on Linux with KDE.

Fig. 6: Output plots for the NGSpice implementation of the HICUM/L2 V2.2 device model.