Part 3: SmartSpice Convergence Tips
Basics to Convergence

- SmartSpice starts with Operating Point Calculations during
  - DC Operating Point & DC Sweep Analyses
  - Transient Analysis without UIC

- SmartSpice constructs system equations and solves them using Newton-Raphson method
Auto Convergence Algorithm Process – 5 Levels

Start

1. Standard Newton Iterations
   - Converged?
   - Yes → EXIT
   - No → DCGMIN stepping

2. DCGMIN stepping
   - Converged?
   - Yes → EXIT
   - No → DiagGMIN stepping

3. DiagGMIN stepping
   - Converged?
   - Yes → EXIT
   - No → Source stepping

4. Source stepping
   - Converged?
   - Yes → EXIT
   - No → Non-convergence diagnostic report

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CONV=0: iteration up to ITL1 limit (default 100)

CONV=1, or 3: ramps DCGMIN with multiplying the factor by 0.1 from DCGMIN*10^{DCGMSTEPS} to DCGMIN iteration up to 4/3*ITL2 limit at basic steps and up to ITL2 limit at additional steps

CONV=2: ramps Jacobi Matrix diagonal increment DiagGMIN with multiplying the factor by 0.1 from GMIN*10^{GMINSTEPS} to GMIN

CONV=4: ramps Source values by adding the factor of Vsource/SRCSTEPS from 0 to Vsource
DC/OP Analysis Convergence Aids

- DCGMIN conductance (1e-12) is placed in all PN junction active devices
- Auto convergence algorithm process – Five levels to achieve good convergence
- Convergence Options
  - ACCEPT
  - CONV
  - DCGMIN
  - DCPATH=
  - EXPERT=777 (779 & 11)
  - GMIN=
  - ITL1=
- Model/Solver-related Option
  - PIVTOL=
- Initial Condition
  - .NODESET, .IC
Transient Analysis Options

- Convergence & Options
  - CNODE=1e-8
  - DCPATH=1
  - GMIN=
  - GNOME=
  - NEWTOL

- Time-step too small
  - OPTIONSET=3
  - OPTIONSET=4
Aids in Overcoming Non-Convergence

- Remove all options except `EXPERT=777, LIST, ACCT`
- Allow SmartSpice auto-convergence to proceed
- Check the diagnostics detail provided by SmartSpice
- Check “Warning” & “Error” message printed from SmartSpice
- Make corrections (circuit topology, node check, unit setting, so on…)
- Run the simulation
- Use Control Options
- During transient analysis, you can try “TRANOP” or “UIC”
- Re-run the simulation
Notes and Restrictions for Using Control Options

**Ex:** “stopcont” options is not available under batch mode

**Ex:** “probe” options only be valid with “post”

**Ex:** Convergence and accuracy options depends on analyses type

**Ex:** Negative Conductance -- Model related

- Options GMINDC=value GMIN=value
  - If the <value> > -1e-8, consult your model provider

- Please refer for more detail to SmartSpice User’s manual

- To achieve “Higher Accuracy” and overcome the “Non-Convergence” issue, it is highly recommend to run SmartSpice before using any options