ESspice Plans for Addons, Bug Fixes, and Improved UX(2022)

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[[1]](#footnote-1)

***Abstract*—I worked really, really hard on my C++ SPICE replica for the coding project, and I would like to continue adding features. The features I would like to add include Bode plot generation, general refactoring+commenting of the source code to make it easier to understand, bug fixes for known bugs, and a better user interface.**

# I. Introduction

I am very proud of my C++ SPICE replica, so I’d like to polish it up so that it holds up as a project I can refer back to for years to come. However, currently there are several issues with it preventing me from feeling truly proud. Also, I’d like to add AC analysis to make it feel more complete.

# II. Refactoring

Currently, the code is a scrambled mess of confusion. Ideally, there should be lots of helpful comments and an intuitive control flow to help those who want to look through my code in the future. Plus, writing cleaner code will likely also help me find and correct bugs.

One of the largest tasks I want to prioritize is putting all MNA stamping in separate functions, localized to each circuit element class. This will speed up the code because I can take advantage of C++ virtual function tables instead of case iteration.

Another thing I want to fix is to put all Newton-Raphson approximation logic in its own function. I’m not certain the best way to do that yet, but when I do it will clean a lot up.

# III. Bug Fixes

I am currently aware of five issues in my code. Ideally, I’d like to fix all five. The fixes I’d like to add include:

* updating all transient models to use trapezoidal approximations,
* making MOSFETs symmetrical/reversable,
* adding MOSFET parasitic capacitances,
* support for plotting branch current and branch voltage, and
* prevention of divide by zero errors in Newton-Raphson approximations.

# IV. Improved UI

At the moment, the user interface is very lacking. As discussed in lecture, the analysis should be separated from the netlist, so that someone could perform any number of analyses on a circuit.

To achieve this, neither nodes nor circuit elements should store voltages/currents. Instead, an analysis class should store all information needed for its own analysis.

This would allow users more flexibility with whatever they want to use the netlist for. For example, this structure would allow a single netlist to be used in a simulation for testing, and for silicon layout to help with fabrication.

Files can still specify which analysis they want to run, but they should only run that analysis once the user has called the “run()” function.

# V. C++ Only

I don’t know if this is possible, but I’d like to see if there’s some way I can call MATLAB methods from C++. Ideally, I’d like to use the provided “.ckt” parser and the MATLAB functions for generating figures. There may be a way I can generate a “.o” from “.m” files. More research is needed.

# VI. Bode Plot Generation

Adding AC analysis would be an incredible added feature. Not only would it be helpful for solving AC circuits, but successfully and cleanly adding AC analysis would mean that my refactoring and improved UI were productive in making my code easier to use.

# VI. Conclusion

This may seem like kind of a short project, but there are lots of things that will deeply challenge me for the next few weeks. I wrote my SPICE replica with the mindset of getting a good grade. However, now I have the opportunity to go back and improve my design to make it more closely match the quality and organization of SPICE.

Plus, if I am able to find a good way of linking C++ and MATLAB, that will be helpful for all similar projects in the future.

Additionally, I am guessing that Bode Plot Generation will be much harder than I am anticipating because that is how every additional feature has felt since capacitors.

I am looking forward to this project of completing all these small(-ish) tasks, and am excited to have a finished SPICE replica I can truly be proud of!

1. [↑](#footnote-ref-1)