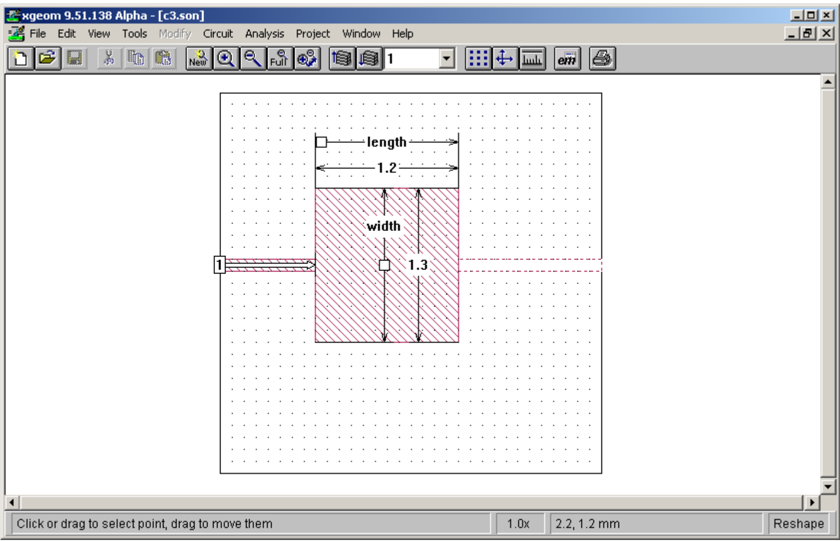
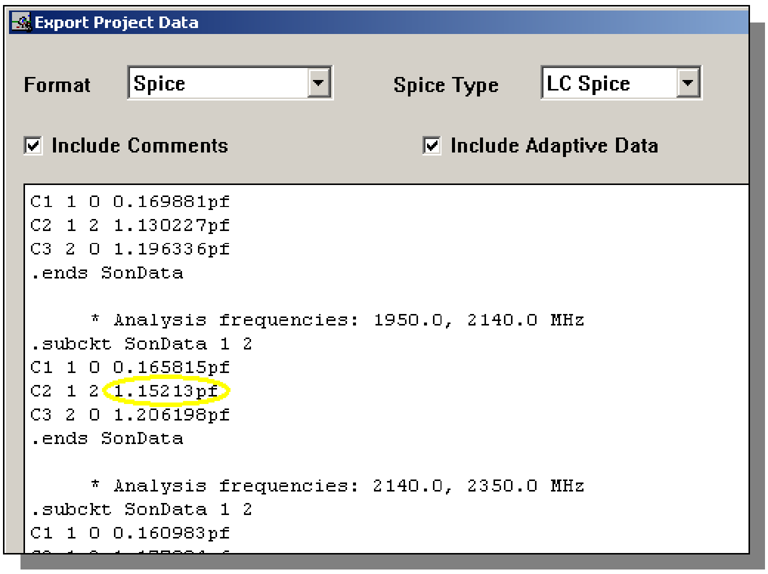
Design of LTCC capacitors and inductors with Sonnet Professional 9

This document gives an overview of some methods used to dimension semi-lumped inductors and capacitor with Sonnet Professional 9.

1. Resize by hand based on equivalent circuit results

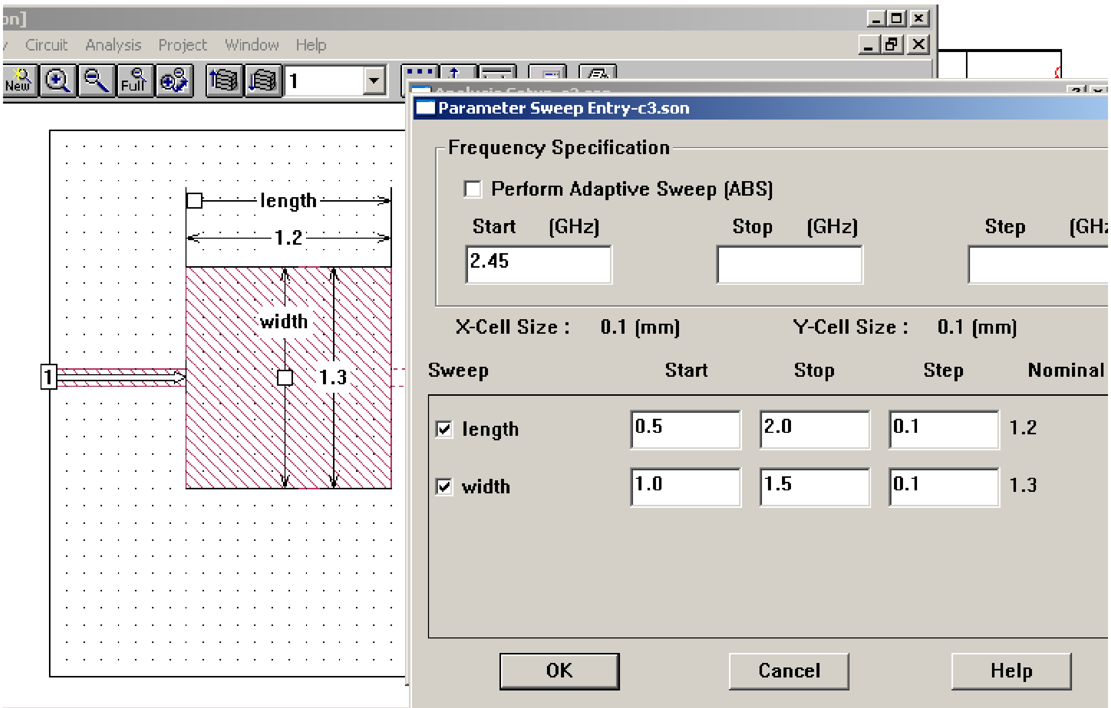
A very basic method to design a inductor or capacitor is to lay out a draft version in the Sonnet xgeom editor, then look at the SPICE output which gives a equivalent circuit model. The equivalent circuit model values are synthesized from EM results at two frequencies. If more than two frequencies have been analyzed, Sonnet will give multiple models, and the user will usually pick one model at the frequency of interest. The advantage of this method is that possible parasitic elements are displayed together with the desired L or C.

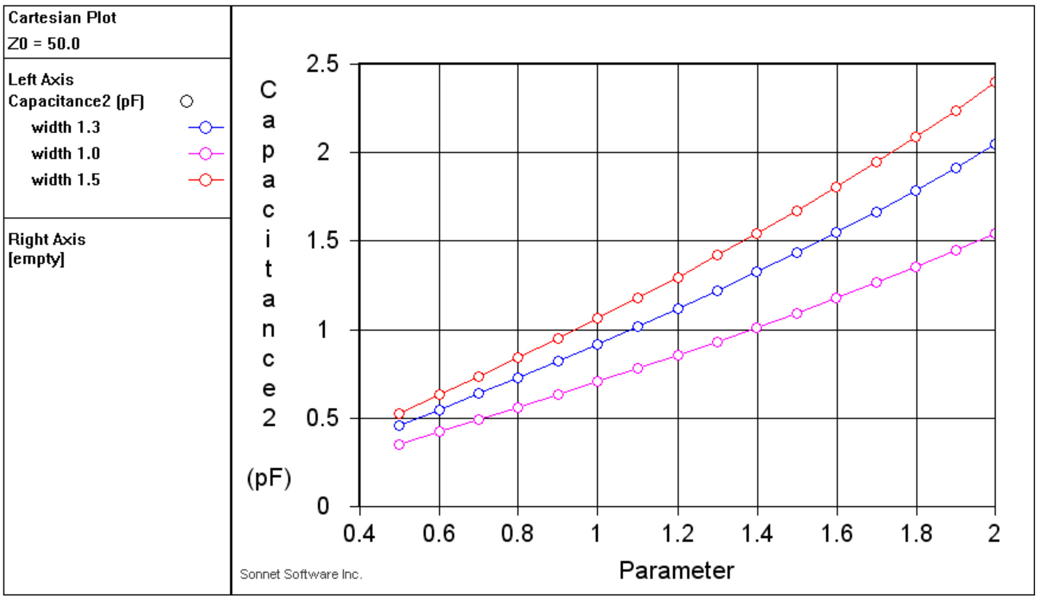




2. *Use geometry parameter sweep to create design table*

With Sonnet Professional 9, it is now possible to plot capacitance and inductance directly as a function of frequency or parameter. This can be used to easily create a design table.
You must first set up geometry parameters, then run a parameter sweep. The parameter sweep can be restricted to the frequency of interest, or it can cover a frequency range. When the analysis is finished, use the Equation Curve function in emGraph to plot the desired parameter. Note that “inductance 1” and “capacitance 1” are the values for a shorted (one port) element, while “inductance 2” and “capacitance 2” are the series elements in a multi port configuration. Possible parasitic elements to ground are included in the one port results, while the multi port results are independent of parasitics to ground. It depends on your application while parameter is required.

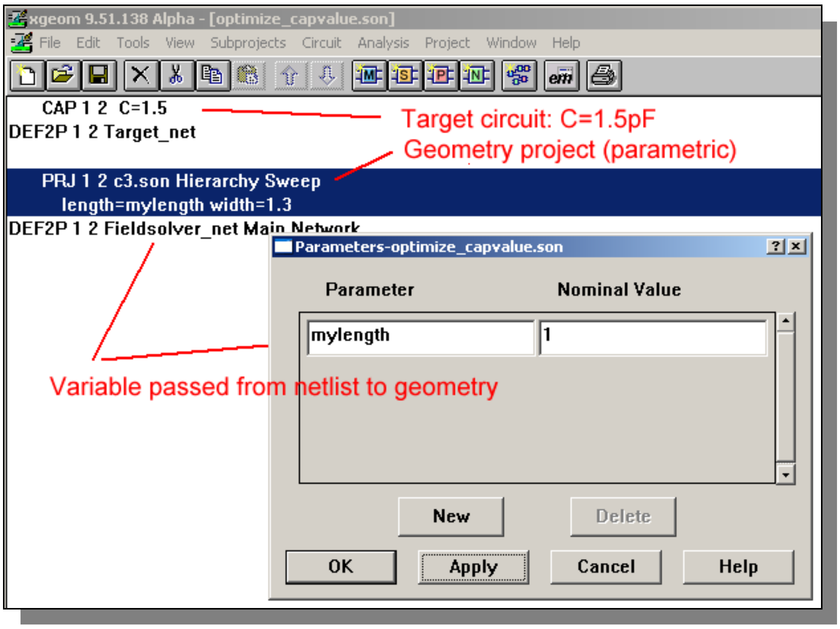




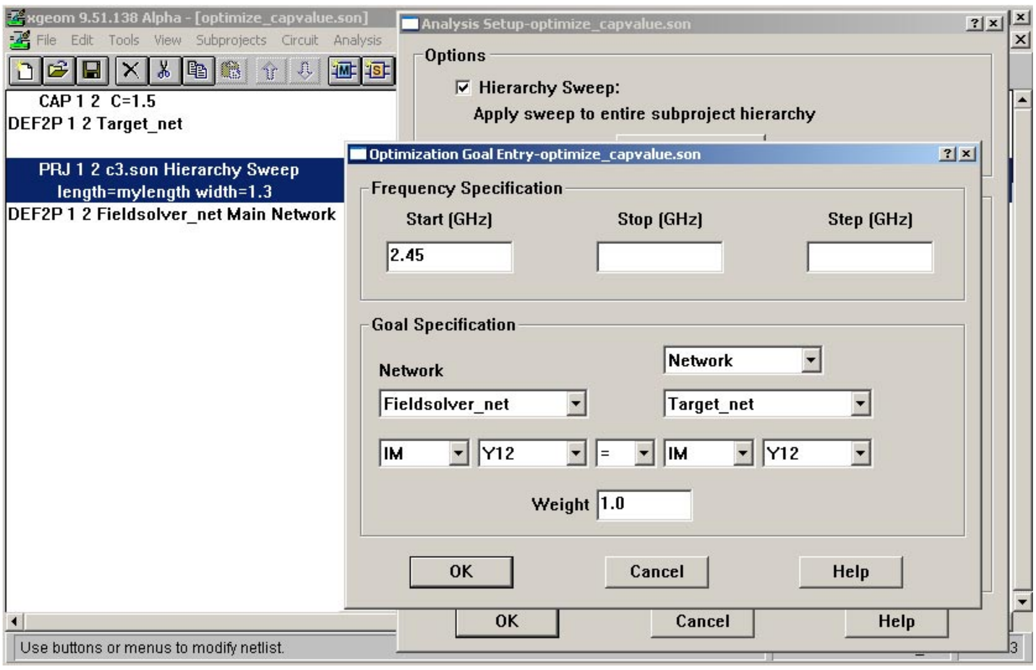
3. *Use optimization with C=xx pF goal*

A very convenient method to re-size layout elements is Sonnet optimization. For that purpose, you need two circuits: a Sonnet geometry model with geometry parameters and a Sonnet netlist with the desired goal as an ideal circuit element. The ideal circuit elements, e.g. capacitor with 1.5pF, defines the optimization goal.

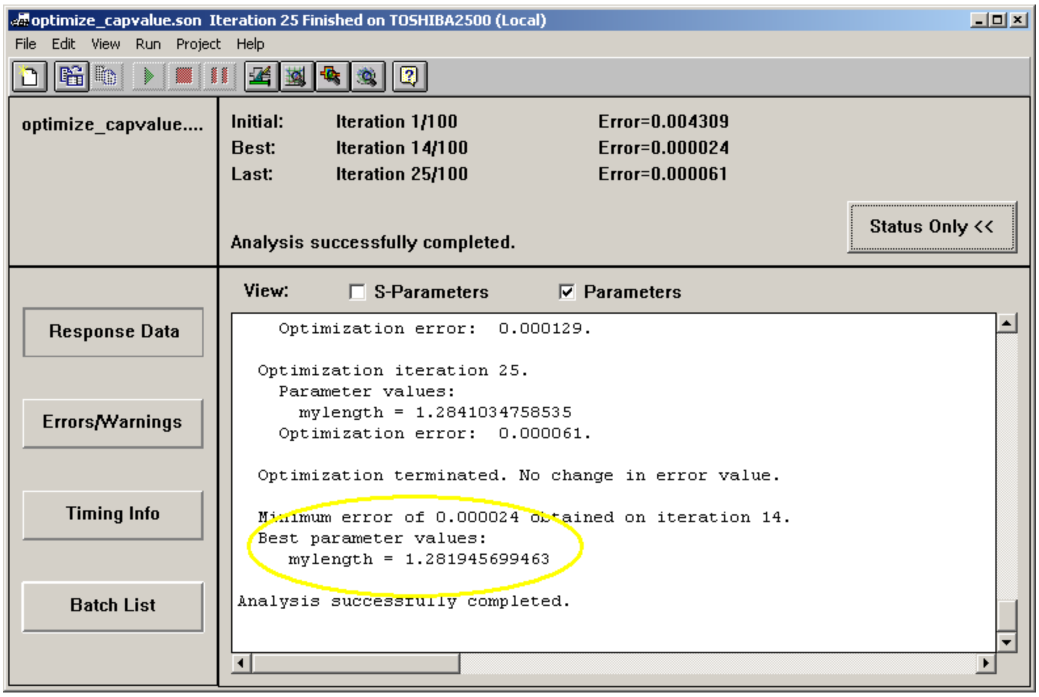
This can be easily implemented in a Sonnet netlist project, which contains one subcircuit for the netlist target and a second subcircuit for the geometry to be tweaked. One or more variables are defined and passed to the geometry project.



To optimize the two port capacitor for the desired value, no matter what parasitic elements might be present, the goal function ca be restricted to find the equal series element (im(Y21)) in both subcircuits, and don't care about shunt elements to ground.



It is sufficient to optimize at a single frequency. When the optimization is done, the analysis monitor will show the optimization result (best parameter values).



You can now incorporate these changes into the geometry model.