Worcester Polytechnic Institute
Department of Electrical and Computer Engineering
ECE3311 Principles of Communication Systems /B05

Exercise#2a
Concept of impedance tuning– parametric sweep in ANSOFT

I. Tuning using approximate analytical formula

In exercise #2, the feed was located exactly on then edge of the patch. This simplification gave the radiation resistance about 85 Ω at the resonance. The antenna is still not tuned quite properly: the input impedance is not exactly 50 Ω.

One way of tuning is to shift the feed position according to approximate Eq. (4) from exercise #2, i.e.

$$R(d) \approx 85\cos^2\left(\frac{\pi(L/2-d)}{L}\right) \quad \Omega \qquad (1)$$

where the dimensions are given in Fig. 1 and 85 Ω is the present edge impedance.

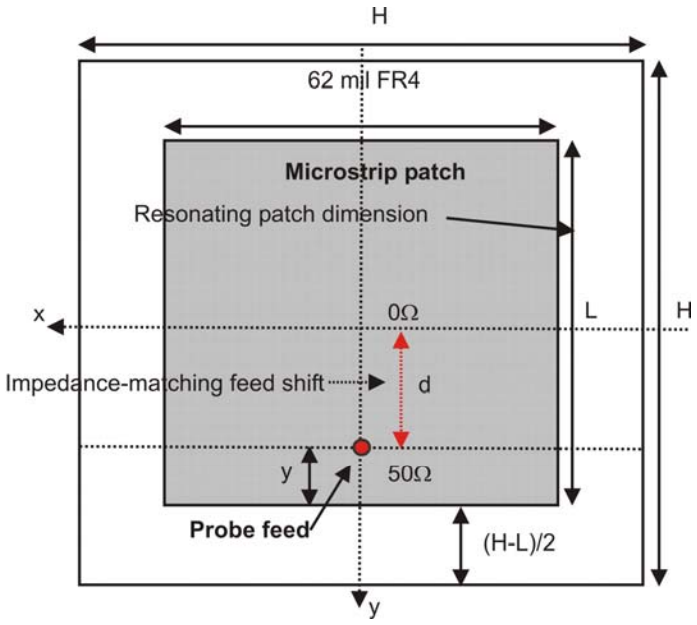


Fig. 1. Geometry of the probe-fed patch antenna and the tuning parameter *d*.

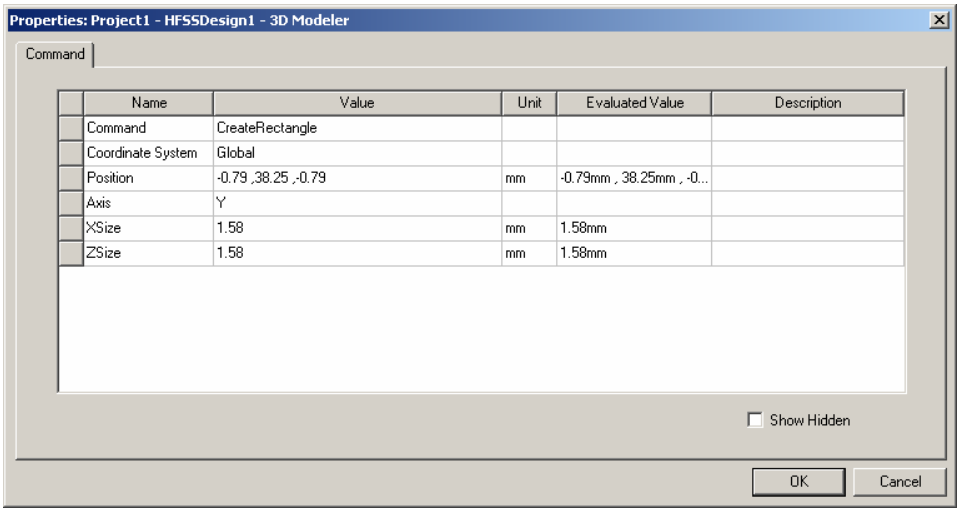
Assuming that $L = 76.5\text{mm}$ and $R(d) = 50\Omega$ please find the proper feed position d from Eq. (1) and record this value:

$d =$	mm

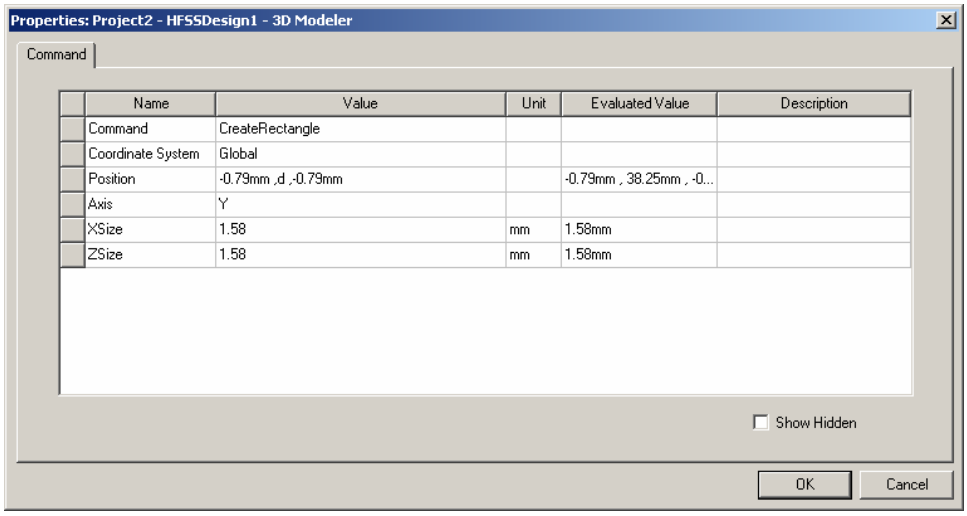
II. Tuning using the parametric sweep

The above result for d is not expected to be very accurate since there is no exact analytical model for any antenna (or the antenna feed), except the so-called electrically small antennas.

Another way to find the proper feed position is to organize the so-called parametric sweep in ANSOFT. To do so open the already existing Project2 for the patch antenna, save it as Project3, and replace the already existing feed definition

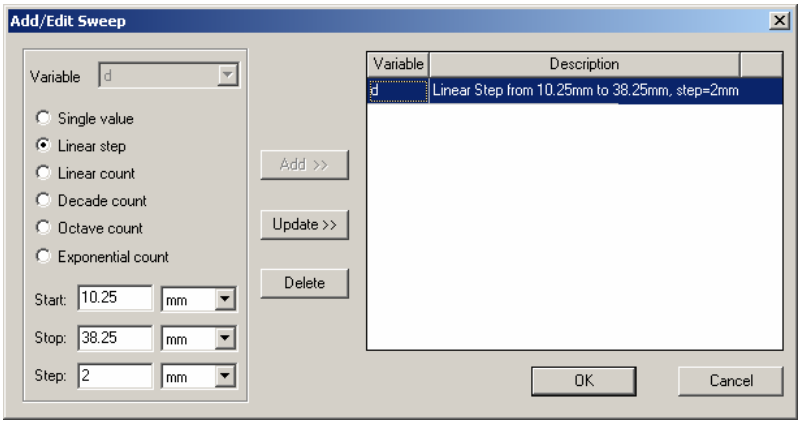


by

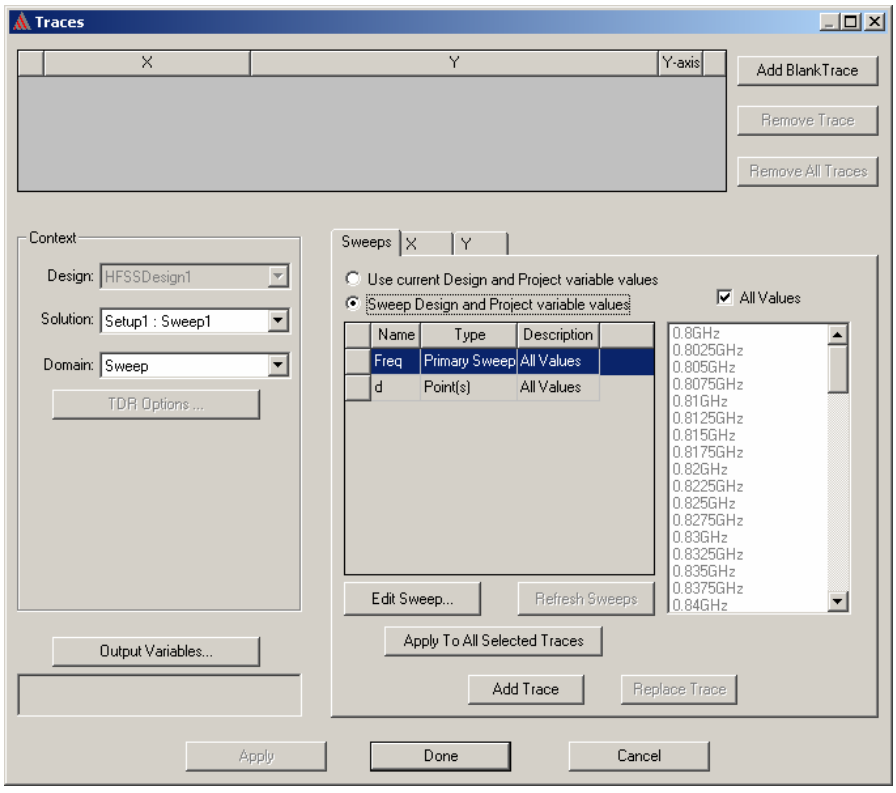


The above operation is equivalent to introducing a new **variable** *d* (the feed position) that can have arbitrary values.

Next, initialize the parametric sweep using submenu OPTIMETRICS/ADD/PARAMETRIC in the project menu (just below submenu ANALYSIS). The initialization should look like this:



Save the project and run the new simulation: it will take a while! After the simulation is ready, go to RESULTS/CREATE REPORT and create the report for S11 using all curves, i.e. introduce the option "Sweep the Project variable":



The plot for S11 should contain a number of curves corresponding to different *d*-values; one of them will have the lowest value of the return loss at the resonance. This is the curve and the *d*-value that we need. Please record this value:

d = mm

The above tuning operation slightly shifts the resonant frequency as it was explained in exercise#2. In order to make sure that the resonant frequency is exactly equal to 920 MHz, return to Project2 (without the sweep), insert the new feed position, and slightly change the size of the patch, say from 76.5 to 76.2mm. This should give the return loss similar to that shown in Fig. 2.

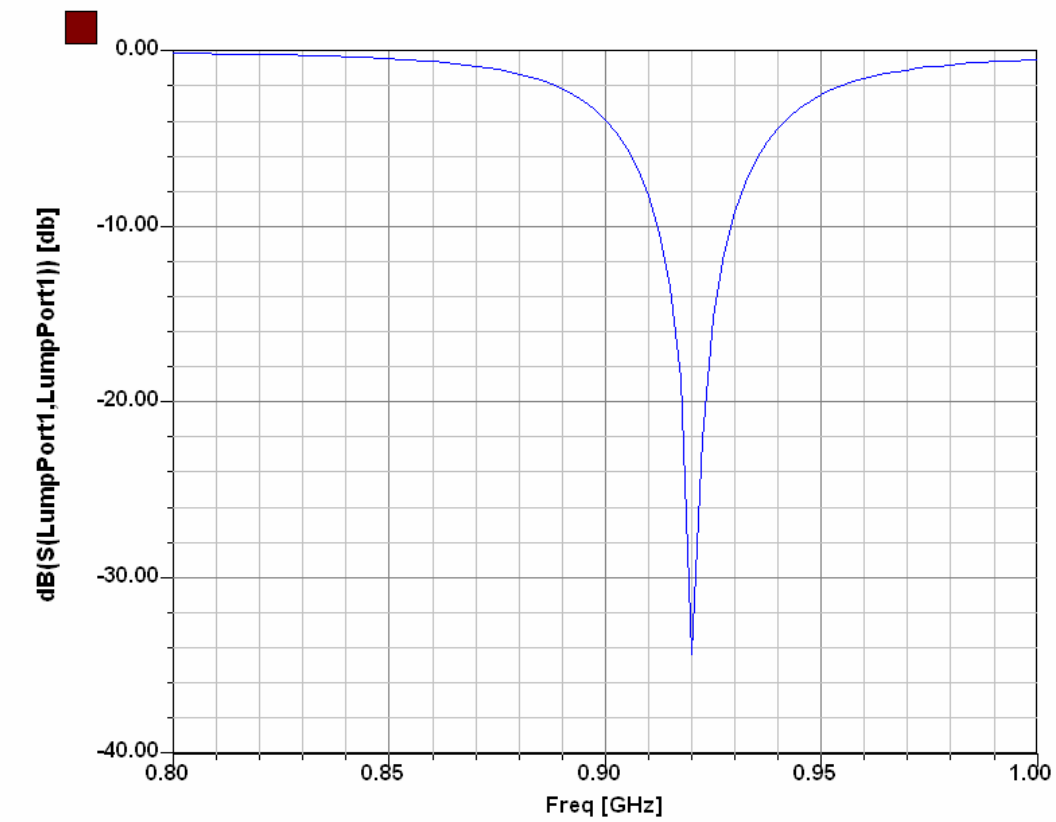


Fig. 2. Return loss for the **properly** tuned patch antenna centered at 920 MHz.

III. Report

A short report to this exercise may be attached to HW#2 on a separate sheet and it should be in the following format:

1. Value of *d* for the analytical approach.
2. Value of *d* for the parametric sweep.
3. Plot of the tuned (the "best") return loss.