Assignment 2 for EC301
Given: 14/3/07
Due: April 2nd morning

14th March 2007

An alien species communicates via microwaves. The atmosphere of their planet happens has a dielectric constant given by

$$\varepsilon = \varepsilon_0 \left(1 + 10^{-12}\omega^2\right), \qquad |\omega| < 10^9 \text{rad/sec}$$

They communicate using pulses whose FWHM ("Full Width at Half Maximum", i.e., the time interval between when the pulse reaches half its peak during the rising phase and when the pulse reaches half its peak during the falling phase) is 100 nsec. The pulses are 200 nsec apart. The message sent consists of the last three digits of your roll number. At what distance do these pulses spread to twice their original width in time? The pulses can be assumed to be

$$E_x(t) = \begin{cases} E_0 \left(1 + \cos\left(2\pi t/T\right)\right) & -T/2 < t < T/2 \\ 0 & \text{else} \end{cases}$$

I have written out the mathematics of this problem in the pulse propagation write up. However, the following needs to be noted:

1. Predict the distance using the theory. Suggestion: fit a gaussian to the pulse and use that to predict pulse spread as a function of distance.
2. Write Scilab code using digital convolutions, not integration.
3. Create the transmitted message (consisting of 8 bits). A "1" bit is a normal pulse, while a "0" bit is a negative pulse.
4. The "fast convolution" is cyclic. Do the needful to make it a linear convolution.
5. The width of a pulse is defined by its FWHM. How will you determine the extent of pulse spreading, given 8 pulses?
6. How does the spreading scale with distance according to the code? Plot both theory and code results in the same plot.
7. I expect Scilab code (not Matlab code) to be submitted, in a LyX file that contains your equations and calculations. Don't come to me and say "it works in Matlab".