FilterViewer

A simple tool for visualizing the layout and analyzing the responses of Microwave filters.

**Abhishek Shrivastava (108107073) and Amey Dharwadker (108107078)**

*3rd Year, B.Tech ECE, 2007-2011*

*National Institute of Technology Trichy (NITT)*

**About the software**

FilterViewer is a JAVA and MATLAB based software for visualizing the layout and analyzing the responses of various types of microwave filters including Interdigital Filters, Tchebychev Low Pass and Butterworth Low Pass Filters.

It is developed by Abhishek Shrivastava and Amey Dharwadker, 3rd Year undergraduate students of Electronics and Communications Engineering Department of National Institute of Technology Trichy, 2007-2011, as an assignment project under Prof. Raghavan of the ECE Department.

***Motivation:***

In the future, learning in modern format will tend to combine theoretical instruction together with the experiment by using computer program, which can make undergraduate student to understand the principle or the theory quickly and effectively. The computer program is an important tool [1], [2], [3], [4] that helps undergraduate student in electrical engineering, especially in telecommunications major to learn the theory to test and develop new ideas. Future more the computer program will assist students to be able to working on more complicated research efficiently. Many courses in electromagnetic and microwave are considered to be the most difficult subjects in the electrical engineering curriculum because the nature of theory courses in which it is usually taught, refer to inform of an abstract and mathematical model. The problem is found in many universities by lacking of modern microwave and simulation program. Thus, we are interested in developing a new computer simulation program to be an education tool [5], [6] for engineering courses.

We have developed a simulation program with an interactive graphical interface for analyzing the characteristics and the layout of microwave band-pass filters using interdigital arrays of resonator line elements between parallel ground planes.

**Interdigital Filters**

***Introduction:***

A recent study has shown that interdigital line structures have very interesting band-pass filter characteristics. In that study, various image-impedance and image-propagation phase properties of interdigital line structures were determined, and the results were verified by experimental tests on an interdigital line structure. In this present discussion a different point of view is utilized to obtain approximate design equations for interdigital filters with specified pass-band and cut-off characteristics.



Our design structure of interdigital filter consists of TEM-mode strip-line resonators between parallel ground planes. Each resonator element is a quarter-wavelength long at the midband frequency and is short-circuited at one end and open-circuited at the other end. Coupling is achieved by way of the fields fringing between adjacent resonator elements. The design equations to be presented for this case (for which the terminating lines are short-circuited) give filter structural dimensions that will be most practical when the filter is of narrow or moderate bandwidth (say, 30 per cent bandwidth or less). In this structure each line element serves as a resonator, except for the input and output line elements which have an impedance-matching function.

***Low Pass Prototype Filters and Low pass-to-band pass Transformation:***

The design procedures to be described are based on the use of low-pass prototype filter element values to give the band-pass filter its desired characteristics. Notice that n is the number of reactive elements and that, including the resistor terminations, the element values range from go to gn+1. A low-pass prototype with n reactive elements leads to a band-pass filter with n resonators.



**Fig: Relation between the low-pass prototype response and the band-pass filter response**

***Design Equations for the Interdigital Band-pass Filter:***

The type of design simulated in our software is most practical for filters having narrow or moderate bandwidth. The main drawback in applying the design procedure in this section to filters of wide bandwidth is that the gaps between Lines 0 and 1 and between Lines n and n+ 1 tend to become inconveniently small when the bandwidth is large, and the widths of Bars 1 and n tend to become very small.

Select a low-pass prototype with the required value of n. The input and output lines in this filter do not count as resonators, so that there are n+2 lines for an n-reactive element prototype.



where h is a dimensionless admittance scale factor to be specified arbitrarily so as to give a convenient admittance level in the fiIter. The normalized self-capacitances Ck/ε per unit length for the line elements are:



where ε is the dielectric constant and εr is the relative dielectric constant in the medium of propagation.

The normalized mutual capacitances Ck,k+1/ε per unit length between adjacent line elements are:



The choice of the value h is made such that the quantity



After calculating all these parameters, the layout was designed for the filter with desired input specifications and the frequency response curve (Attenuation in dB versus the normalized frequency) was also plotted.

**Graphical User Interface (GUI) Details**

***Main Features:***

* New Project Wizard for creating new projects
* Open Project Wizard can open existing projects saved anywhere in the harddisk
* Save Project Wizard can save a project after modifying anywhere in the harddisk
* The main windows consist of tabs for handling multiple projects at the same time.
* The graphs and layouts are generated using MATLAB and hence incorporates all the features like 3-D viewing, rotating, zooming, labeling, coloring, etc
* At most 15 projects can be opened and worked with simultaneously.

***Requirements:***

* MATLAB (7.6 or above) must be installed and working properly.
* Eclipse IDE for JAVA.
* FilterViewer software source codes.

***Installation:***

*Assumptions:*

* *MATLAB installation directory*

C:\Program Files\MATLAB\R2008a

* *Eclipse IDE installation directory*

C:\Eclipse

* *FilterViewer codes directory*

C:\FilterViewer

*Note: Please change the above directories in the following steps depending on where you installed the required programs.*

* Make sure the following lines are in the MATLAB Java CLASSPATH.

C:\FilterViewer\java\micfilter

C:\FilterViewer\java

C:\Eclipse\plugins

C:\Eclipse\plugins\org.eclipse.swt.win32.win32.x86\_3.2.2.v3236.jar

C:\Eclipse\plugins\org.eclipse.swt\_3.2.2.v3236b.jar

C:\Eclipse\configuration\org.eclipse.osgi\bundles

C:\Eclipse\configuration\org.eclipse.osgi\bundles\79\1\.cp

To add the above lines, in the MATLAB prompt, type

edit classpath.txt

and add those lines in the editor which opened.

* Make sure the following lines are in the MATLAB Current Directory Path.

C:\FilterViewer\matlab

Execute this command with the above directory path:

addpath C:\FilterViewer\matlab

* Make sure the following lines are in your operating systems PATH environment variable.

C:\Program Files\MATLAB\R2008a\bin;

C:\Program Files\MATLAB\R2008a\bin\win32;

C:\Program Files\MATLAB\R2008a\java\jar; C:\Eclipse\configuration\org.eclipse.osgi\bundles\79\1\.cp;

C:\Eclipse\configuration\org.eclipse.osgi\bundles;

*How to do it in Windows:*

1. Right-click on “My Computer” icon in Desktop or “Computer” icon from Start Menu and go to “Properties”.
2. Go to “Advanced System Settings” or click on “Advanced tab”, whichever exists.
3. Click on “Environment Variables” button and from the “System variables” list select the variable called “Path”.
4. Then click on “Edit” and then append the above lines (separated by semi-colon) in “Variable value” field.

***Running the application:***

* Open MATLAB and type the following in the MATLAB prompt:

micfilter.MICFilter.main({});

***About GUI:***

The GUI has been entirely written using the JAVA programming language. Specifically, the SWT (Standard Widget Toolkit) Technology is used, which can be found in the Eclipse IDE by default. It was written with the help of Eclipse IDE and was interfaced with the MATLAB software for backend computations, using the MATLAB’s *com.mathworks.jmi* package. This package comes installed with the MATLAB software already.

**References**

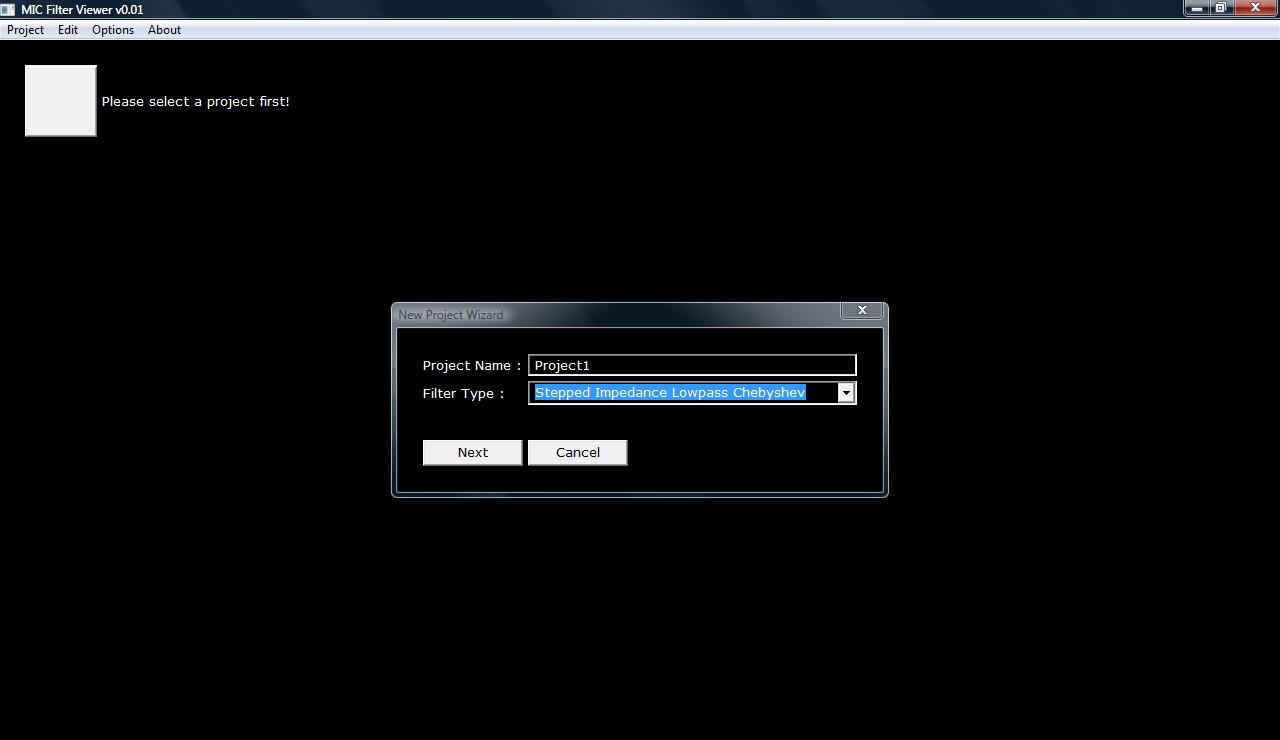
[1] George L. Mathei, “**Interdigital Band-Pass Filters**”. IRE Transactions on Microwave Theory and Techniques.

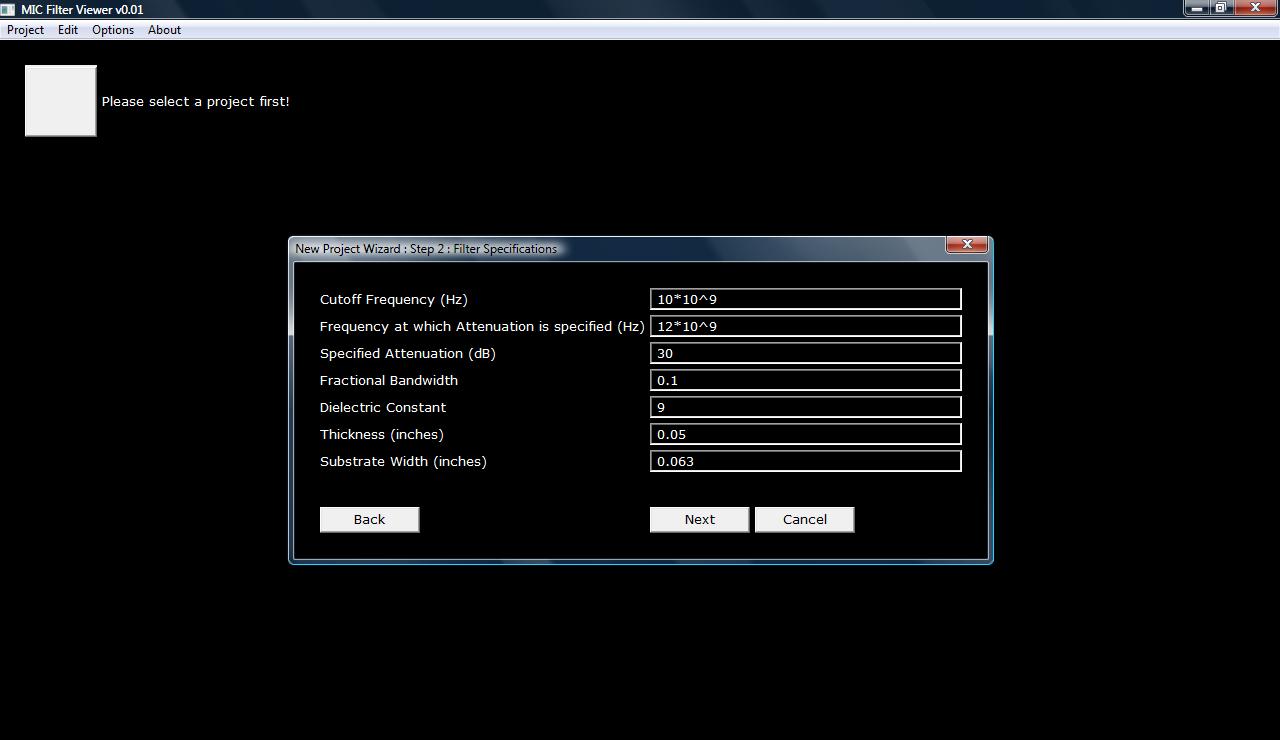
[2] Chen Chao, Wu Qon, “**Fast Design and Optimization of Bandpass Tapped-Line Interdigital Filters Using GENESYS**”, IEEE Transactions.

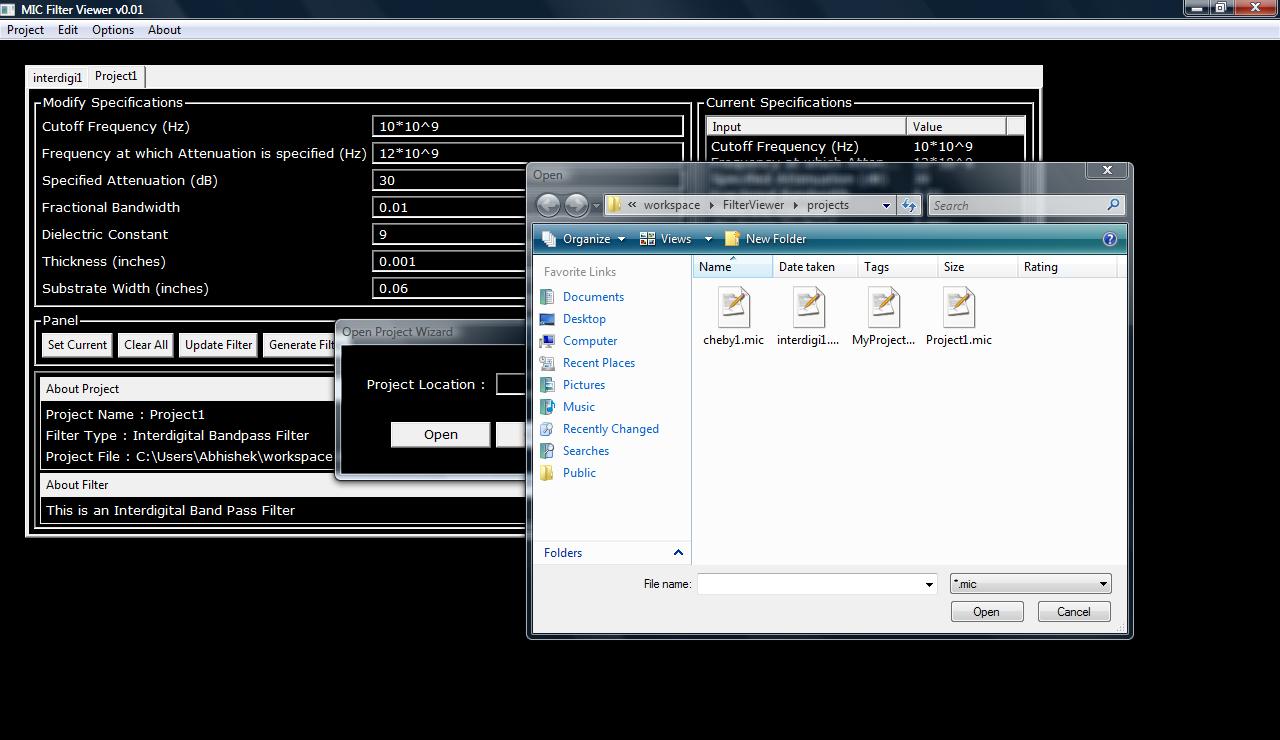
[3] “**Reference Data for Radio Engineers**”, Federal Telephone and Radio Corporation.

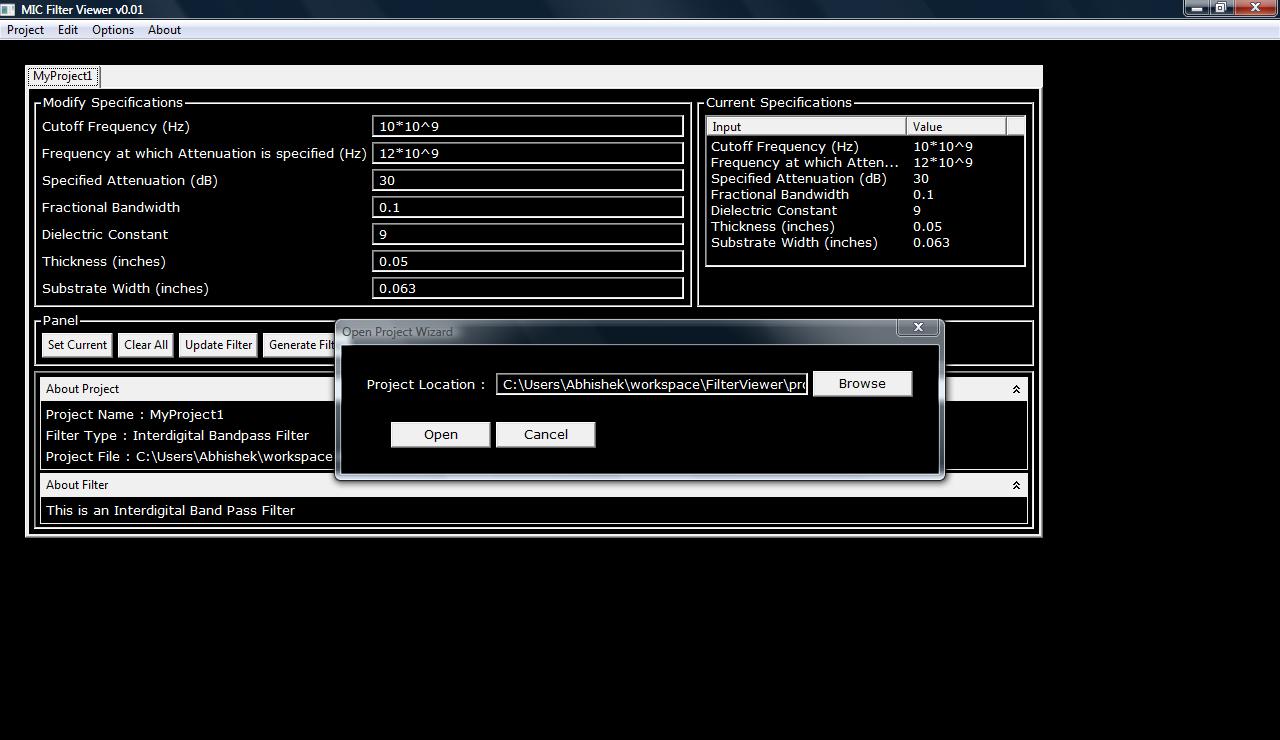
[4] A.M. Nassar, A.M. Moselhy, M.A. El Gazzar, “**Design and Simulation of Microwave Filter**”, IEEE Journal

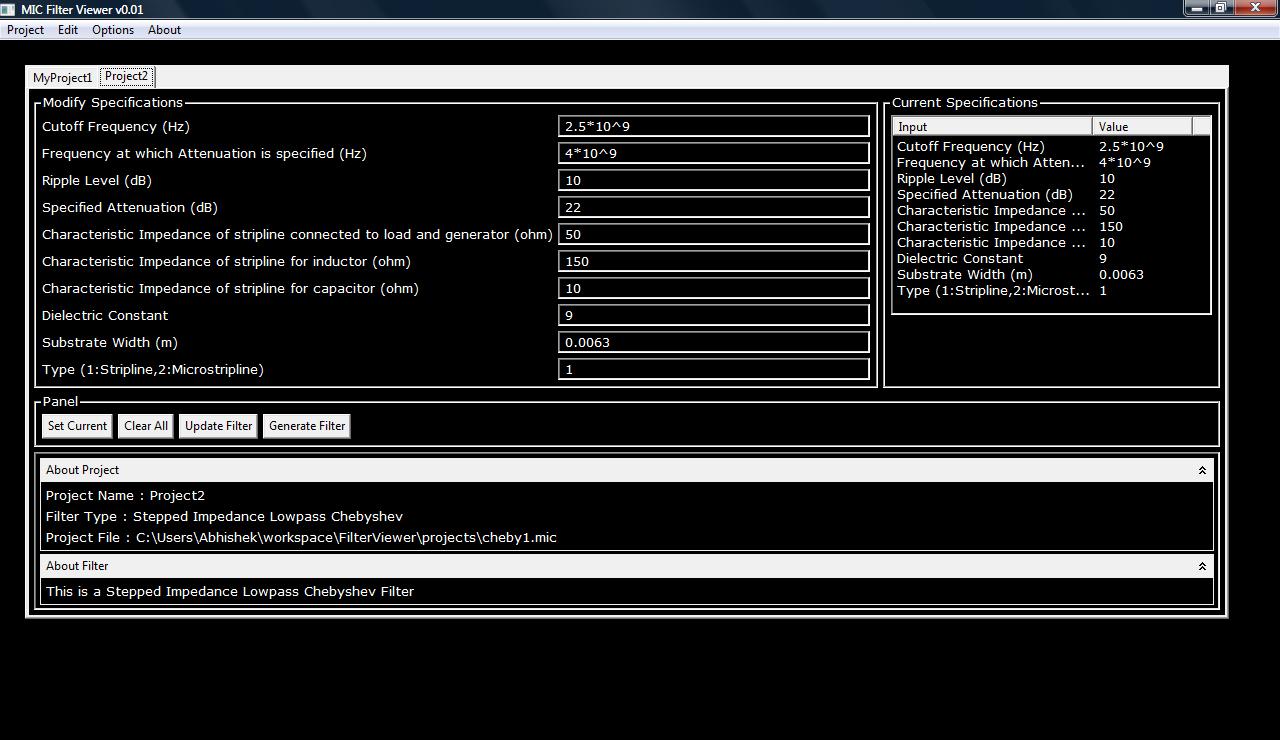
**Screen Shots**

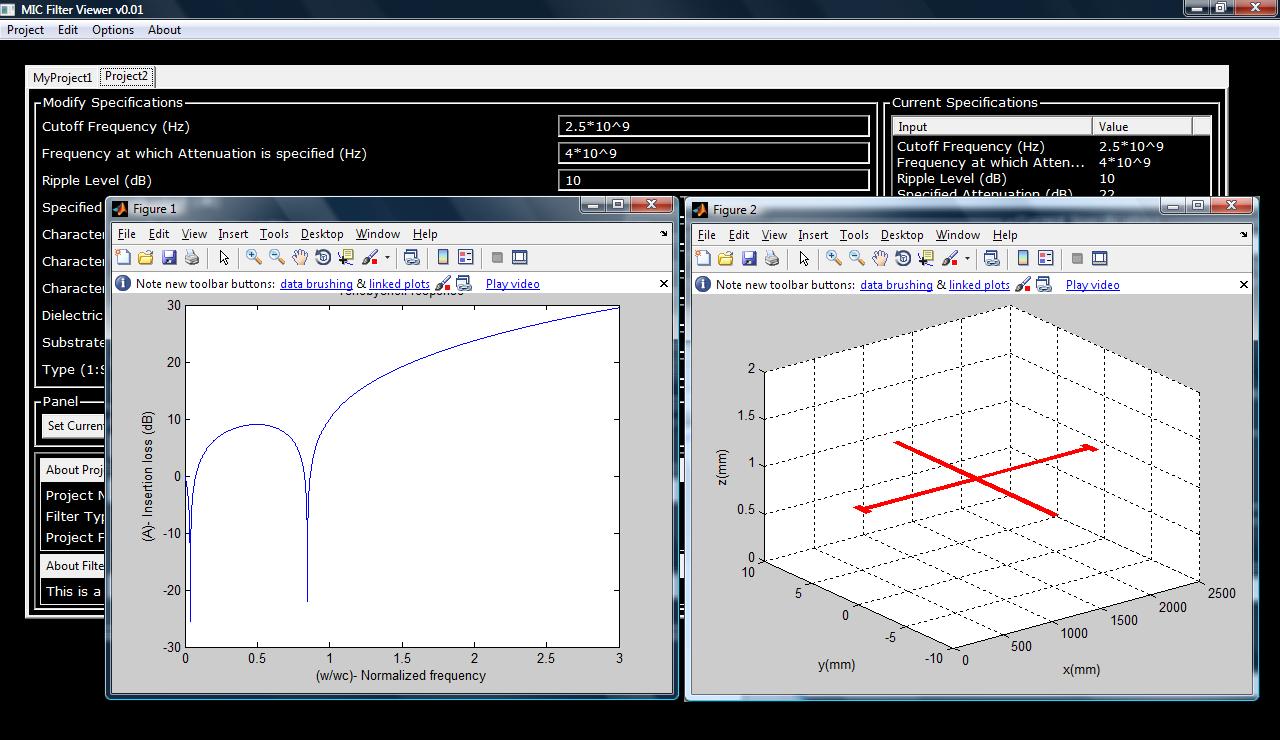
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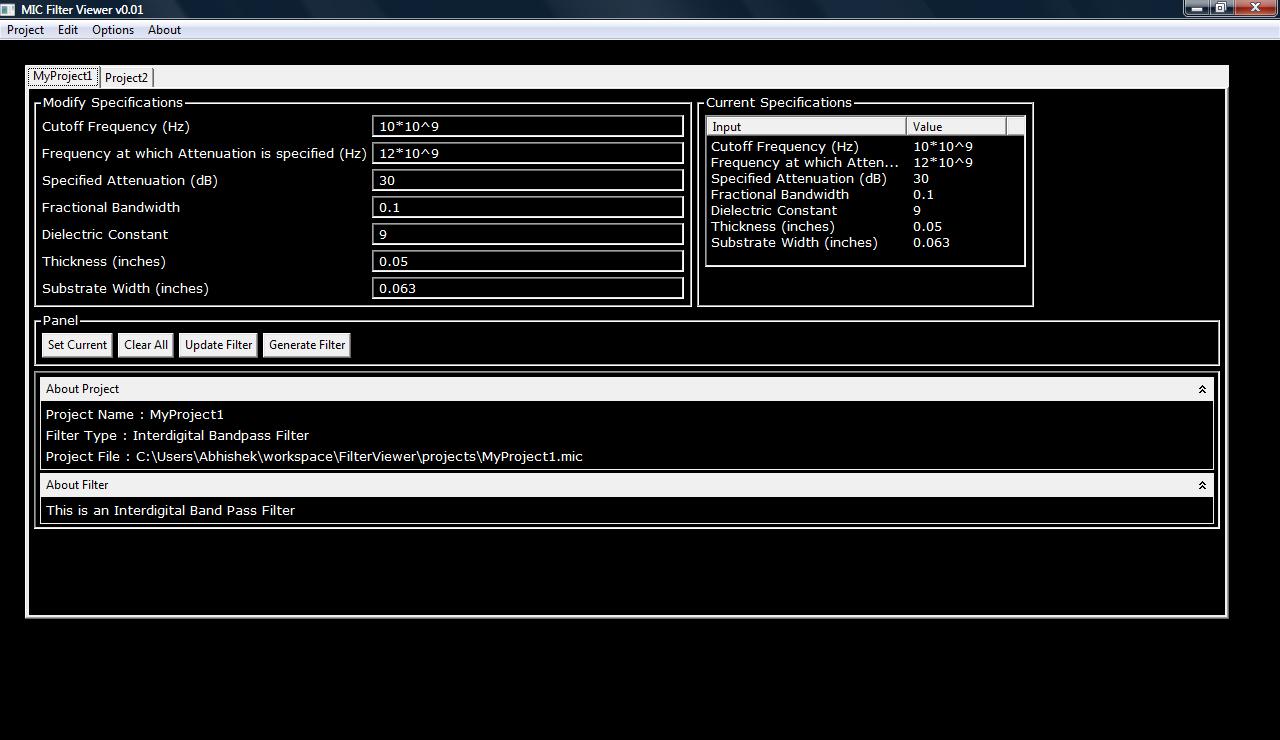
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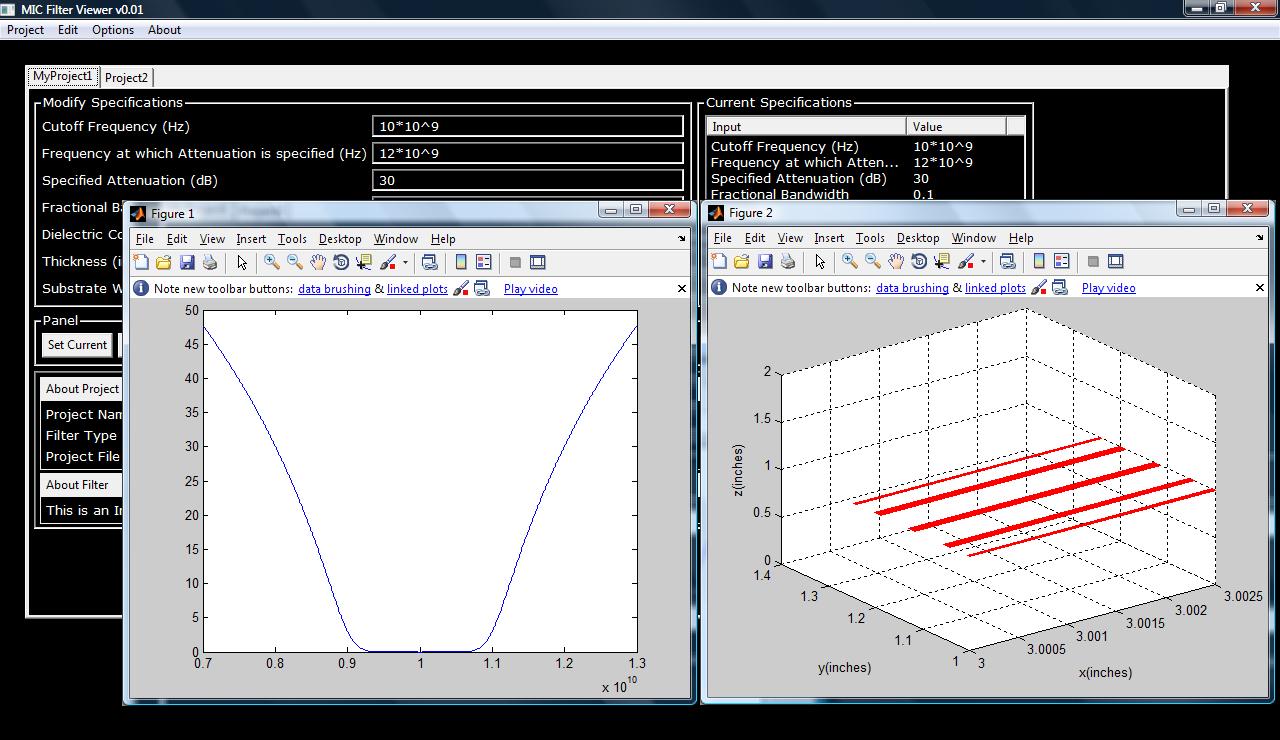
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