Exploring the Custom Analysis Interface for use with MATLAB on Tektronix Oscilloscopes

This demo guide provides several examples of applying the Custom Analysis Interface for use with MATLAB available on Tektronix DPO/DSA/MSO5k/7k/70k Oscilloscopes. This high performance interface enables live custom analysis with full integration of MATLAB procedures into the Tektronix oscilloscope.

Custom analysis is performed during the oscilloscope signal-acquisition loop with results returned as a math trace on the instrument, allowing users to rapidly complete advanced analysis and debug tasks. MATLAB procedures hosted on the oscilloscope benefit from a shared memory interface to acquired waveform data, establishing a live data environment that can be fully customized for specific types of analysis.

Extensive MATLAB visualization features can also be applied to create specialized data views that are fully synchronized with oscilloscope operation. These custom views can enable additional insight and efficiency when analyzing complex signals.

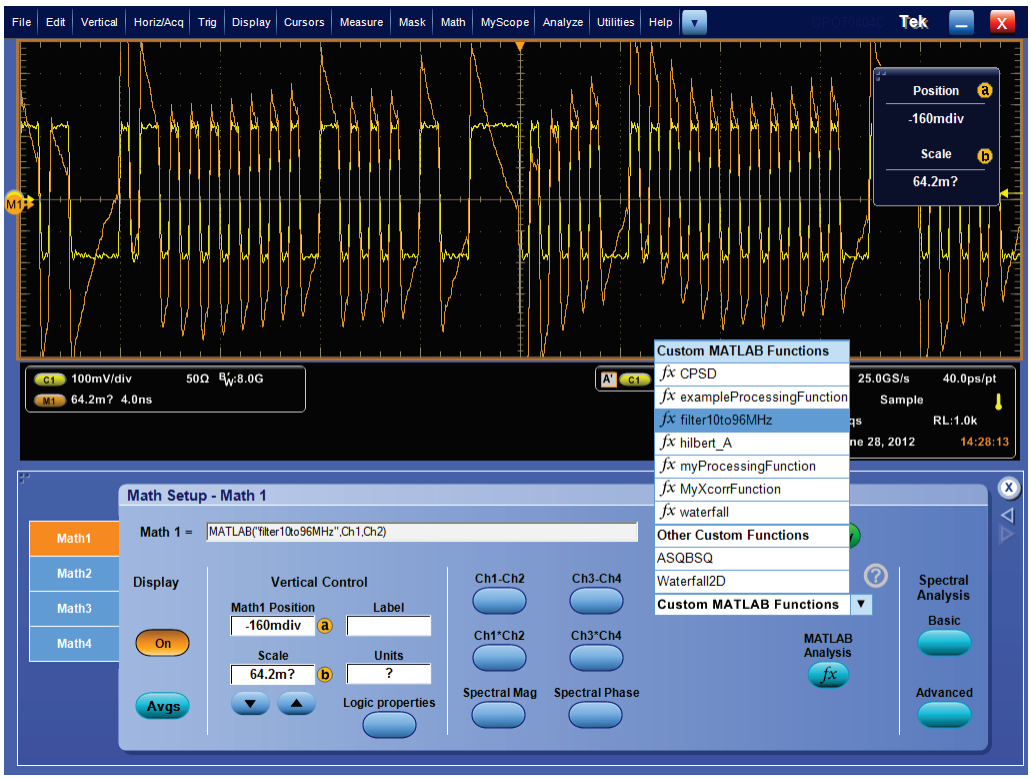
Built-in examples of applying MATLAB-based custom analysis provide a good starting point to gain understanding and develop new solutions. Each example will be described in a demonstration-style setting.

Accessing Custom Analysis Functions

Custom Analysis functions appear in the Math Setup control window in a selection list control.

Sample functions included with the instrument are shown in the adjacent figure.

In this example, a Math1 expression is defined to perform custom filtering on an input signal by selecting "filter10to96MHz" from the Custom MATLAB Functions list.



This function applies a digital IIR filter to Ch1 data and returns the result in Math1. The filter has been designed to provide stop-band filtering from 10 MHz to 96 MHz. The effect on a 2.5 Gbps serial data signal can be seen in the figure above.

This demonstration shows how easily custom analysis functions can be invoked and managed from inside the oscilloscope user interface.

Training Board III (TB-3) and instrument settings for this demonstration

- Cable TB-3 Fast Serial Data (+) output to oscilloscope Ch1 input
- Select TB-3 Demo 0, Step 0 2.5 Gbps CJTPAT
- Default Setup on instrument (4 ns/div, 25 GS/s, 1k Samples)
- Enter Math Setup control window, select **"filter10to96MHz"** from the Custom MATLAB Functions list to create the following math expression:

  Math1 = MATLAB("filter10to96MHz", Ch1, Ch2)

- Observe Ch1 and Math1 and effects this filter has on the input signal
- Notice the live update and use Run/Stop or Single to control acquisitions
- Optionally, change trigger to select an interesting part of the input signal:

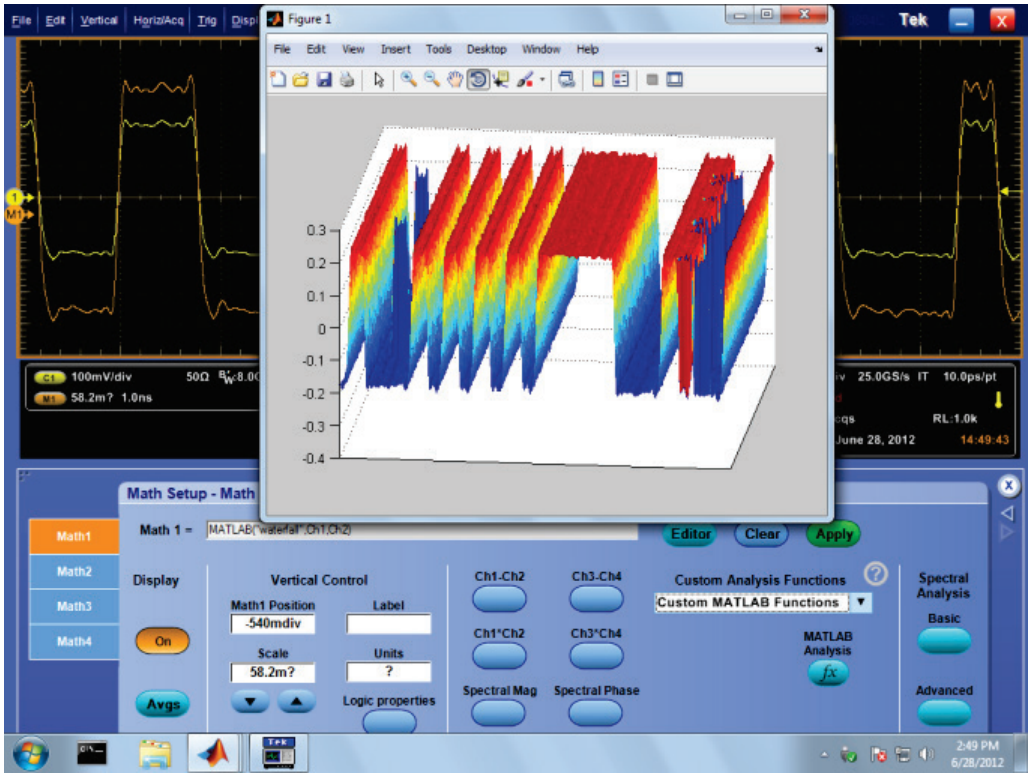
  Select Trigger Type: Glitch, Glitch Width Greater Than and set the time for 1.8ns

CustomVisualization

Powerful visualization of MATLAB on live scope data on the instrument

This is a visualization example using 3D view to show signal behavior over time

Manipulate the plot using MATLAB features like viewing angle and color map.



Training Board III (TB-3) and instrument settings for this demonstration

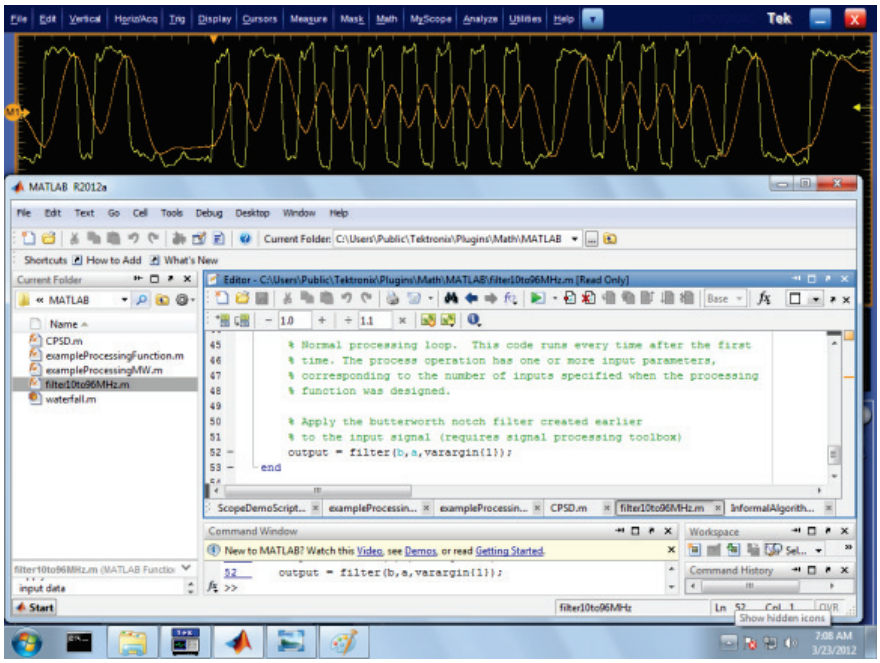
This setup is the same as previous with addition of steps 4 and 5

1. Cable TB-3 Fast Serial Data (+) output to oscilloscope Ch1 input
2. Select TB-3 Demo 0, Step 0 2.5 Gbps CJTPAT
3. Default Setup on instrument
4. Set Horizontal Scale to 1 ns/div
5. Select Trigger Type: Glitch, Glitch Width Greater Than and set the time for 1.8ns
6. Enter Math Setup control window, select **"waterfall**" from the Custom MATLAB Functions list to create the following math expression:
   i. Math1 = MATLAB("waterfall", Ch1, Ch2)
7. Using a keyboard and Alt-Tab, select the waterfall plot window to make visible on top of scope
8. Notice the live update and use Run/Stop or Single to control acquisitions
9. Optionally use the 3D rotation tool on the MATLAB plot toolbar to manipulate the view:
   - Click on the 3D tool  icon
   - Move the mouse into the whitespace below the waterfall, left-mouse down and drag

MATLAB – Scope interaction and Basic Template

This demonstration illustrates the tightly synchronized operation between MATLAB procedures and the Tektronix oscilloscope.

Custom analysis functions developed with this interface are notified when new acquisition data is available and perform processing on this data immediately. Oscilloscope processing and display operations wait for processed data to be returned then update the display, keeping all views synchronized. This method enables immediate analysis of new data and increases update rate.



Show tight control and interaction with MATLAB environment
Load basic Output=Input example
View in MATLAB environment
Set breakpoint in MATLAB on I/O line, notice that acquisition stops
View the contents of Input by plotting the workspace variable
Delete the breakpoint and resume
Clear the math expression on the instrument
Go to MATLAB and modify the processing function; save it
Apply the updated function and see new outcome

Training Board III (TB-3) and instrument settings for this demonstration

This setup is the same as previous or first

10. Cable TB-3 Fast Serial Data (+) output to oscilloscope Ch1 input
11. Select TB-3 Demo 0, Step 0 2.5 Gbps CJTPAT
12. Default Setup on instrument
13. Set Horizontal Scale to 1 ns/div
14. Select Trigger Type: Glitch, Glitch Width Greater Than and set the time for 1.8ns
15. Enter Math Setup control window, select **"myProcessingFunction"** from the Custom MATLAB Functions list to create the following math expression:
    i. Math1 = MATLAB("myProcessingFunction", Ch1, Ch2)

Two-input Functions

Either one or two waveforms can be passed to MATLAB functions

This is a two-input, one-output example

Demo 0, Step 0, Event Off; 40ns/div, 25GS/s, 10k, Ch1: HSS(+), Ch2: Sig A, Trig: Edge on Ch2