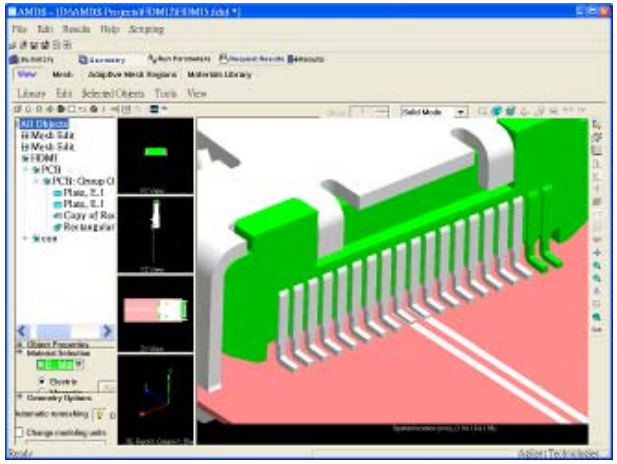
# EM Insights Series



## Episode #6:

High Speed Connector Modeling With EMPro

Agilent EEsof EDA
November 2008

# Application Overview

## Typical situation

High speed connectors are widely employed for high speed digital signal transmission. With the progress of technology, more advanced transmission interfaces are used such as the Universal Serial Bus (USB), Digital Video Interface (DVI), High Definition Multimedia Interface (HDMI), etc. High speed connectors compatible with these interfaces are also advancing. Since these connectors are used for applications up to10.2Gbit/s (for HDMI), accurate modeling and simulation of them becomes critical to successful  high speed signal transmission.

## Potential users and targeted market

- High speed connector/socket manufacturers

## EM product used

- Electromagnetic Professional (EMPro)

# Design Challenge

## Design challenge

The HDMI has emerged as the data transmission standard for HDTV and other consumer electronics. Since HDMI is transmitting digital data without compression, it eliminates signal interference and attenuation usually required for traditional connection standards. An HDMI connector is a compact size connector that has up to 29 pins. The main design challenge is to maintain a good impedance profile (continuity) throughout multiple interconnect transitions, especially at high speed data rates.

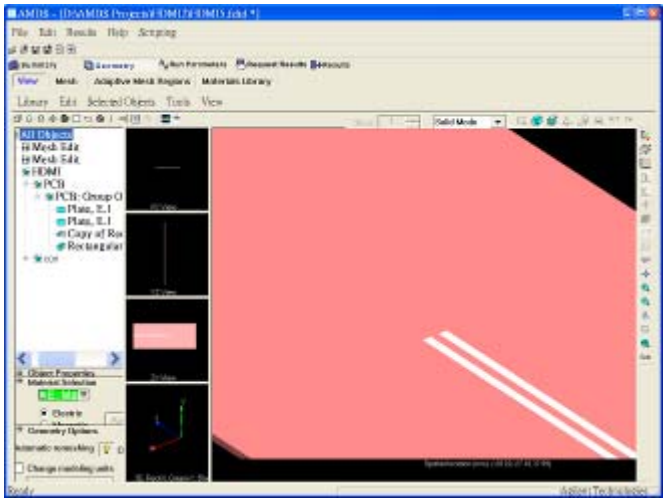
## Problem solved

Speed of the time domain EM simulator helps in identifying problem areas, and discontinuities of connectors. Running multiple simulations in a fraction of the time lets you understand and optimize for a good impedance profile throughout the transitions. As a result, high performance connector designs can be achieved.

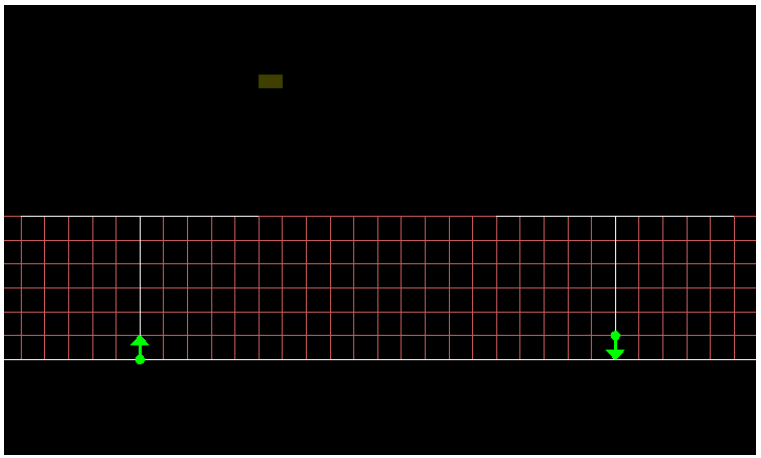
## Value delivered

Faster and cheaper design of high speed connectors through accurate and fast EM simulations

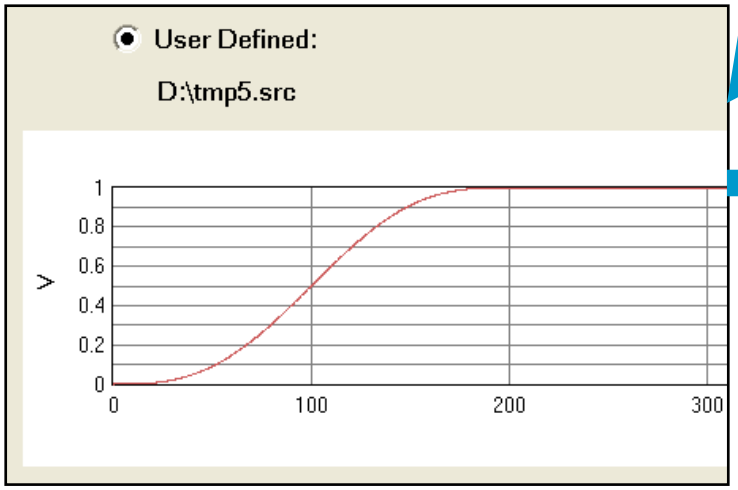
# Modeling Connector's Impedance



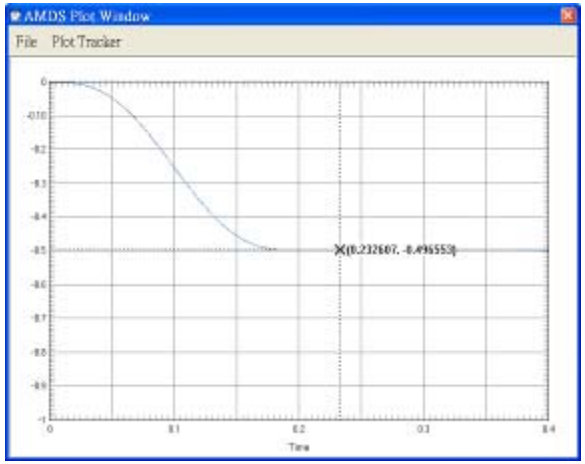
1. Build 100 ohm differential pair



2. Define differential sources




3. Assign step waveform



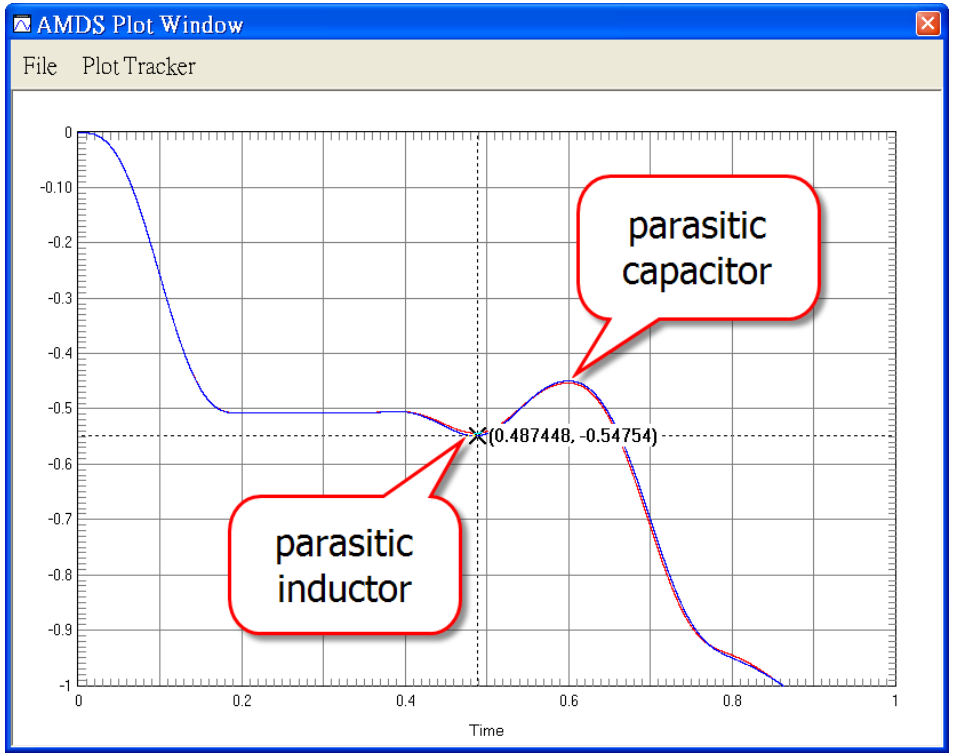

4. Simulate TDR signal

# Sample Step Waveform with Python Script Language

```
sample_number=20000
time_step=222.4e-15
rising_time=100e-12
filename='c:/tmp5.src'
u=rising_time/2
s=rising_time/2
derivative=[]
sample=range(sample_number)
time=[X*time_step for X in sample]
voltage=[(1+(x-u)/s+(1/pi)*(sin((x-u)*pi/s)))/2 for x in time if x<=rising_time]
y=(sample_number-len(voltage))*[1.0]
voltage=voltage+y
for i in range(len(voltage)-2):
    derivative.append((voltage[i+1]-voltage[i])/time_step)
derivative.append(0.0)
derivative.append(0.0)
voltage.reverse()
derivative.reverse()
my_file=open(filename,'w')
my_file.write(str(sample_number)+'\n')

while voltage!=[]:
    my_file.write(str(voltage.pop())+' '+str(derivative.pop())+'\n')
my_file.close()
```

# Simulation Results on Impedance Plot




Memory consumed: 314.26 MB

Simulation time: 20 mins
(with one Acceleware card)

$$Z = 100*(V1+V2)/(2-(V1+V2)) = 100*1.08/(2-1.08) = 117\ \text{Ohm}$$

# EM Insights Series

## Episode #6 Summary

Time domain EM simulation makes it easy to get the impedance data through the interconnect transitions. It also provides more efficient meshing to handle complicated 3D structures and faster simulation. The result is faster and cheaper designs of high speed connectors.

### Interested in learning more about this application?

- Request an evaluation copy of EMPro
  http://www.agilent.com/find/eesof-empro-evaluation
- Request a demo of EMPro
  http://www.agilent.com/find/eesof-contact

www.agilent.com

**For more information about Agilent EEsof EDA, visit:**

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