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# Waveform Comparison & S2IBIS3 Roadmap

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Lance Wang [lwang@iometh.com](mailto:lwang@iometh.com)

IO Methodology Inc.



# Agenda



- **Waveform Comparison**
  - Methods
  - Example
  
- **S2IBIS3 Roadmap**

# Waveform Comparison



- Background
  - Mainly interested by Signal Processing designs
  - It needs to be used in Signal Integrity Analysis
    - For the tolerance
    - For the worst cases
    - For the results expected
  - It is needed for automations
  - This is one of the methods and could be the best one for Signal Integrity analysis

\*patent pending

# Waveform Comparison



- What interested
  - Vertical differences (Voltage, Current, Magnitude Values vs. Time, Frequency, etc.)
  - Horizontal differences (Timing, etc.)
  - Difference Peak
    - Difference Peak Value
    - Difference Peak Index
  - Difference Average
    - Average Difference Value
    - Average Difference Index

# Waveform Comparison



- Differential Peak\* (DP) and Differential Peak Index\* (DPI)

- The DP is defined as the following

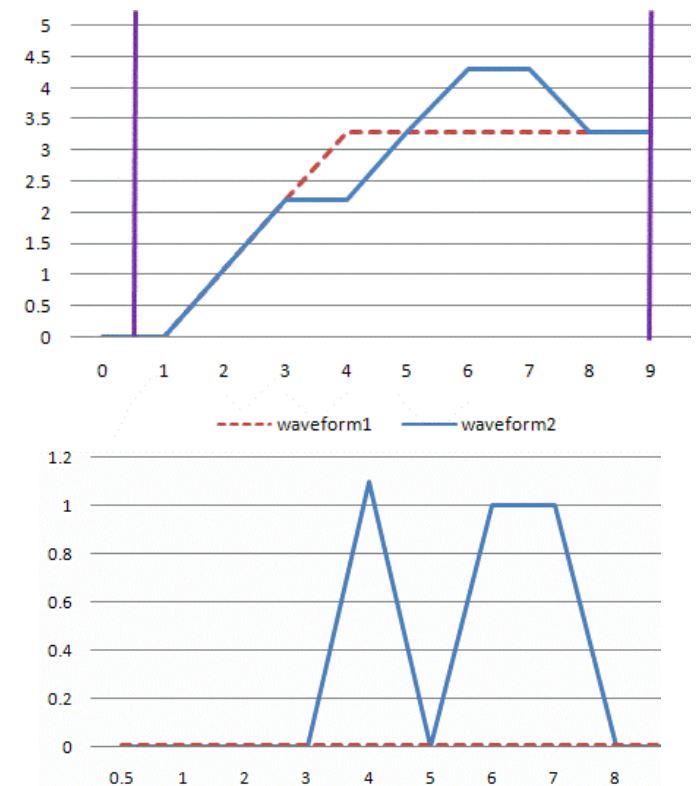
$$DP = \text{Max}_{t \in [T_{Start} T_{End}]} (|W_2(t + offset) - W_1(t)|)$$

Where, [Tstart/Tend] is the comparison window which the user defined.

DP can show the largest difference in the comparison window between the two waveforms.

- The DPI is defined as below

$$DPI = \frac{DP}{\text{Max}_{t \in [T_{Start} T_{End}]} W_1(t) - \text{Min}_{t \in [T_{Start} T_{End}]} W_1(t)} \times 100\%$$



# Waveform Comparison



- Differential Average\* (DA) and Differential Average Index\* (DAI)
  - The DA is defined as the following

$$DA = \frac{\sum_{i=1,3,5,\dots}^N \int_{T_i}^{T_{i+1}} |W_2(t + offset) - W_1(t)| dt}{DL}$$

$$DL = \sum_{i=1,3,5,\dots}^N [(T)_{i+1} - T_i]$$

- The DAI is defined as below

$$DAI = \frac{DA}{\frac{\text{Max}_{t \in [T_{Start}, T_{End}]} W_1(t) - \text{Min}_{t \in [T_{Start}, T_{End}]} W_1(t)}{}} \times 100\%$$

# Waveform Comparison



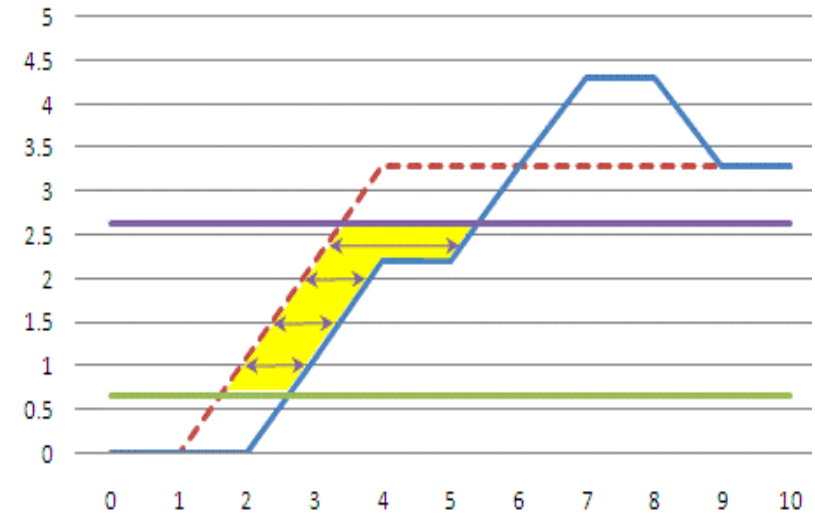
- Timing Differential Peak\*(TDP)

$$\text{TDP} = \text{Max}_{y \in [Y_{\text{bot}}, Y_{\text{top}}]} (|T_2(y) - T_1(y)|)$$

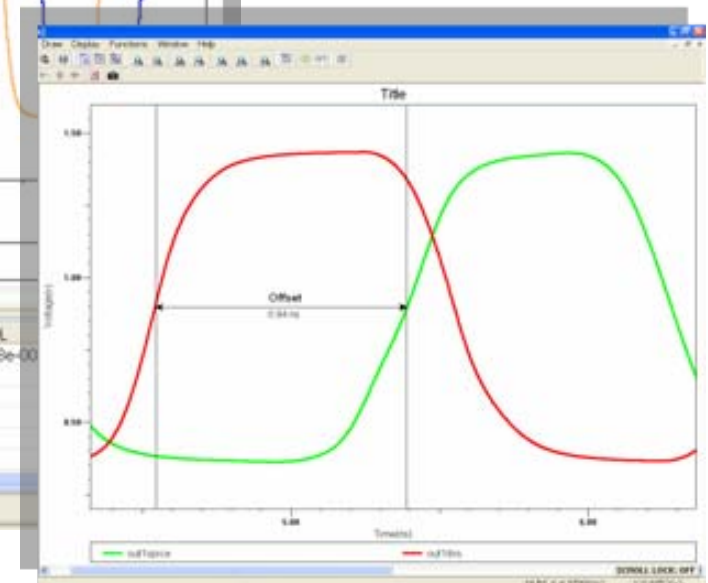
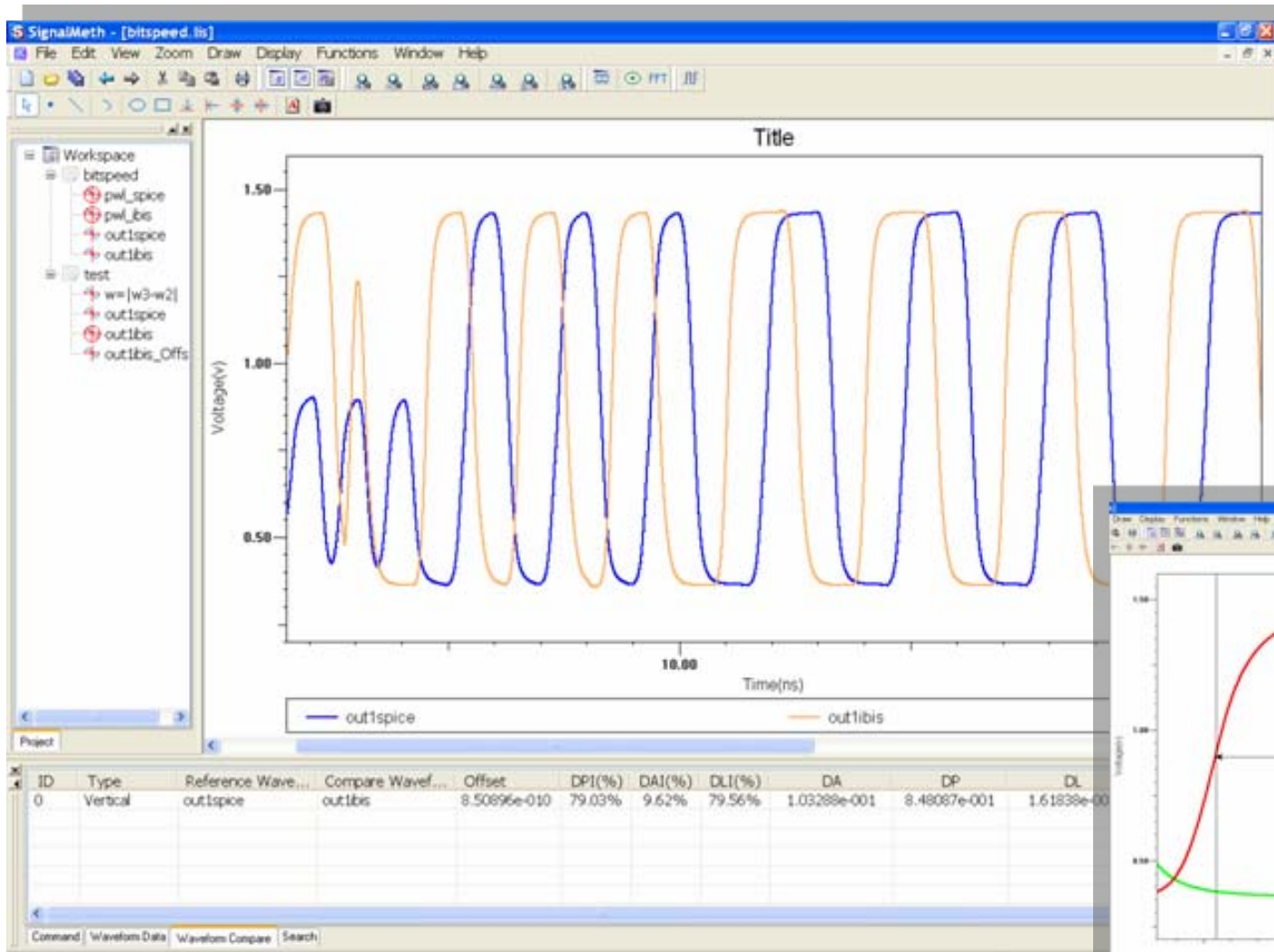
- Timing Differential Average\* (TDA)

$$\text{TDA} = \frac{\sum_{i=1,3,5,\dots}^N \int_{Y_i}^{Y_{i+1}} |(T_2(y) - T_1(y))| dy}{\text{TDL}}$$

$$\text{TDL} = \sum_{i=1,3,5,\dots}^N [(Y)_{i+1} - Y_i]$$



# Waveform Comparison





# Waveform Comparison



**Waveform Comparison**

Vertical | Horizontal(Timing)

Reference Waveform: out1spice  
Compare Waveform: out1ibis  
Start Time: 2.574745e-009s  
End Time: 2.291609e-008s  
Noise Threshold: 0.5mv

Offset Compare Waveform

Offset Value 0s

Offset by Reference Voltage

Reference: 8.999310e-001v  
Xstart: 1.371269e-008s  
Xend: 1.530226e-008s

Offset by Minimum Timing DI

Xstart: 3.360000e-008s  
Xend: 4.200000e-008s  
Yup: 1.007244v  
Ydown: 0.792617v  
Timing NT: 1ps

Setting Check Run Stop OK Cancel

Reference Schematic:  
Waveform1  
Waveform2  
Reference  
X\_start X\_end

Waveform1  
Waveform2  
Reference  
X\_start X\_end

**Waveform Comparison**

Horizontal(Timing)

Reference Waveform: out1spice  
Compare Waveform: out1ibis  
Start Time: 2.574745e-009s  
End Time: 2.291609e-008s  
Noise Threshold: 0.5mv

Offset Compare Waveform

Offset Value 0s

Offset by Reference Voltage

Reference: 8.999310e-001v  
Xstart: 1.371269e-008s  
Xend: 1.530226e-008s

Offset by Minimum Timing DI

Xstart: 3.360000e-008s  
Xend: 4.200000e-008s  
Yup: 1.007244v  
Ydown: 0.792617v  
Timing NT: 1ps

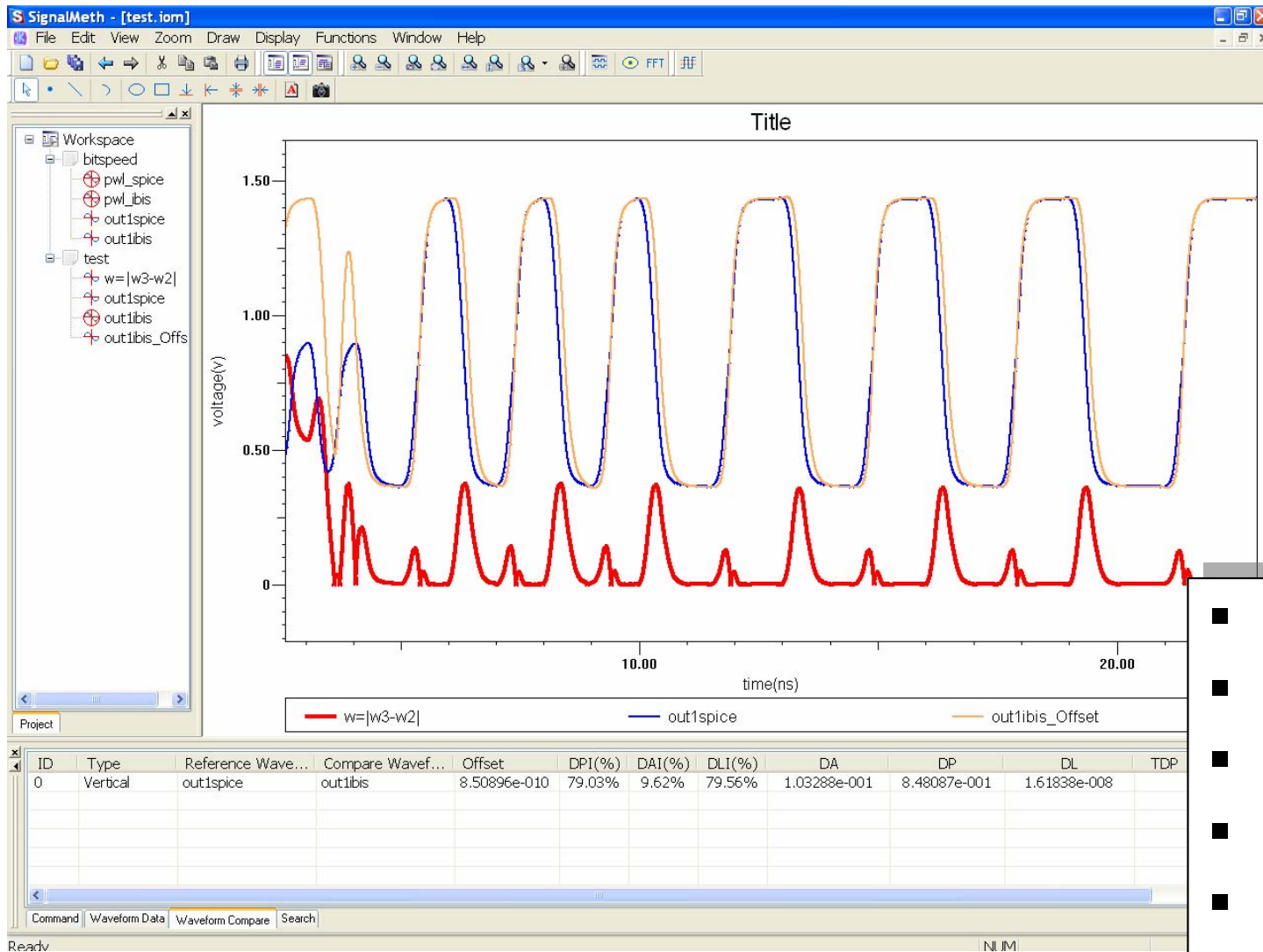
Setting Check Run Stop OK Cancel

Reference Schematic:  
Waveform1  
Waveform2  
Y up  
Y down  
X\_start X\_end

Waveform1  
Waveform2  
Y up  
Y down  
X\_start X\_end

Shifting waveform

# Waveform Comparison



- Offset = 0.85ns
- DP = 0.848
- DPI = 97%
- DA = 0.103
- DAI = 9.6%

# S2IBIS3 Roadmap



- S2IBIS3 was developed and supported by NCSU
  - Ambrish Varma is the main developer
- IO Methodology is proud to provide supports for S2IBIS3
- New home page:  
<http://iometh.com/Product/s2ibis3/index.html>
- New support page:  
[http://iometh.com/Product/eval/s2ibis3\\_support.html](http://iometh.com/Product/eval/s2ibis3_support.html)

# S2IBIS3 Roadmap



- Model selector
- Submodel (dynamic clamping)
- Manipulating VT/VI curves (Best Point)
- Single corner generation
- Bird 95/98
- Differential pair (pseudo and true)
- GUI
- Parser integration



The Hope starts here!

[www.IOMeth.com](http://www.IOMeth.com)