SerDes Toolbox™

Getting Started Guide

MATLAB® & SIMULINK®

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SerDes Toolbox™ Getting Started Guide

Revision History

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1

Getting Started with SerDes Toolbox

SerDes Toolbox Product Description

Design SerDes systems and generate IBIS-AMI models for high-speed digital interconnects

SerDes Toolbox provides a MATLAB® and Simulink® model library and a set of analysis tools and apps for the design and verification of serializer/deserializer (SerDes) systems.

With the SerDes Designer app, you can use statistical analysis to rapidly design wired communications transmitters and receivers. The app provides MATLAB based parameterized models and algorithms that let you explore a wide range of equalizer configurations and generate eye diagrams to assess performance metrics.

With building blocks such as CTLE, DFE, FFE, and CDR, you can describe your chosen architecture and simulate control and adaptation algorithms. White-box examples of typical applications such as PCIe, USB, Ethernet, and DDR provide reference designs that you can use as a basis for your own designs.

SerDes Toolbox supports automatic generation of dual IBIS-AMI models. These models can be used with third-party channel simulators for system integration and verification.

2

Introduction to SerDes

Design SerDes System and Export IBIS-AMI Model

This example shows how to use the SerDes Designer app to create and analyze a SerDes system, and create the IBIS-AMI models for the transmitter and receiver from Simulink®. Design the top-level SerDes system in the app, then export a Simulink model for further time-domain analysis. Export the IBIS-AMI models for the finalized SerDes system from Simulink.

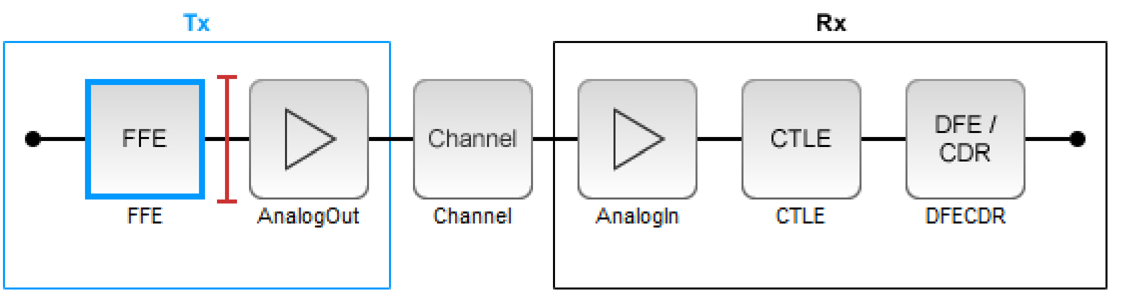
Configure SerDes Designer App

Open the SerDes Designer app by typing the following command in the MATLAB command prompt:

```
>> serdesDesigner
```

Alternately, in the **Apps** tab, under **Signal Processing and Communications**, click the app icon.

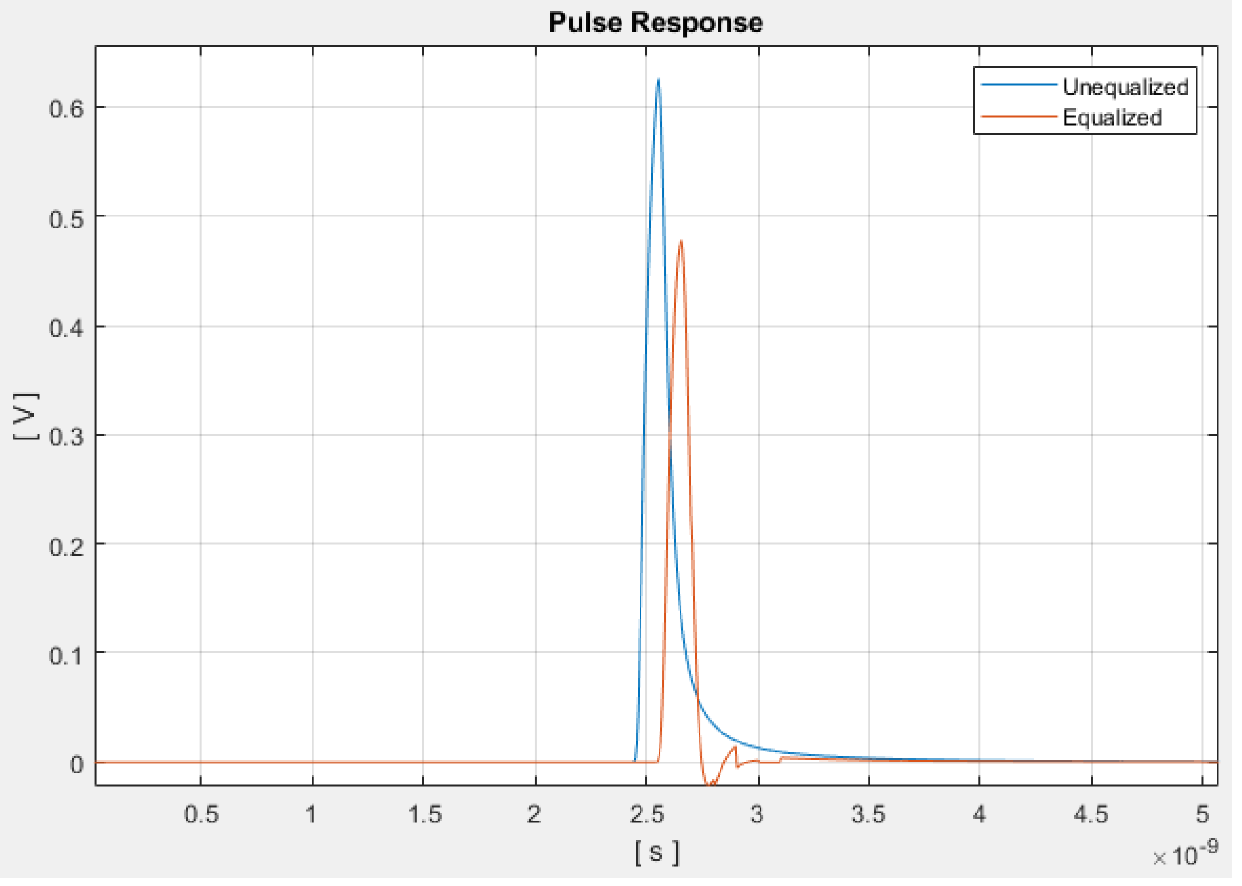
In the **SerDes System** window, select AnalogOut block and add an FFE block to its left. Then select the AnalogIn block and add a CTLE and a DFECDR block to its right.



Select the FFE block in the Tx subsystem. In the **Block Parameters** window, change **TapWeights** from `[0 1 0 0 0]` to `[0 1 0 0]`, so that the FFE has one pre tap, one main tap, and two post taps. Leave all other blocks in their default settings.

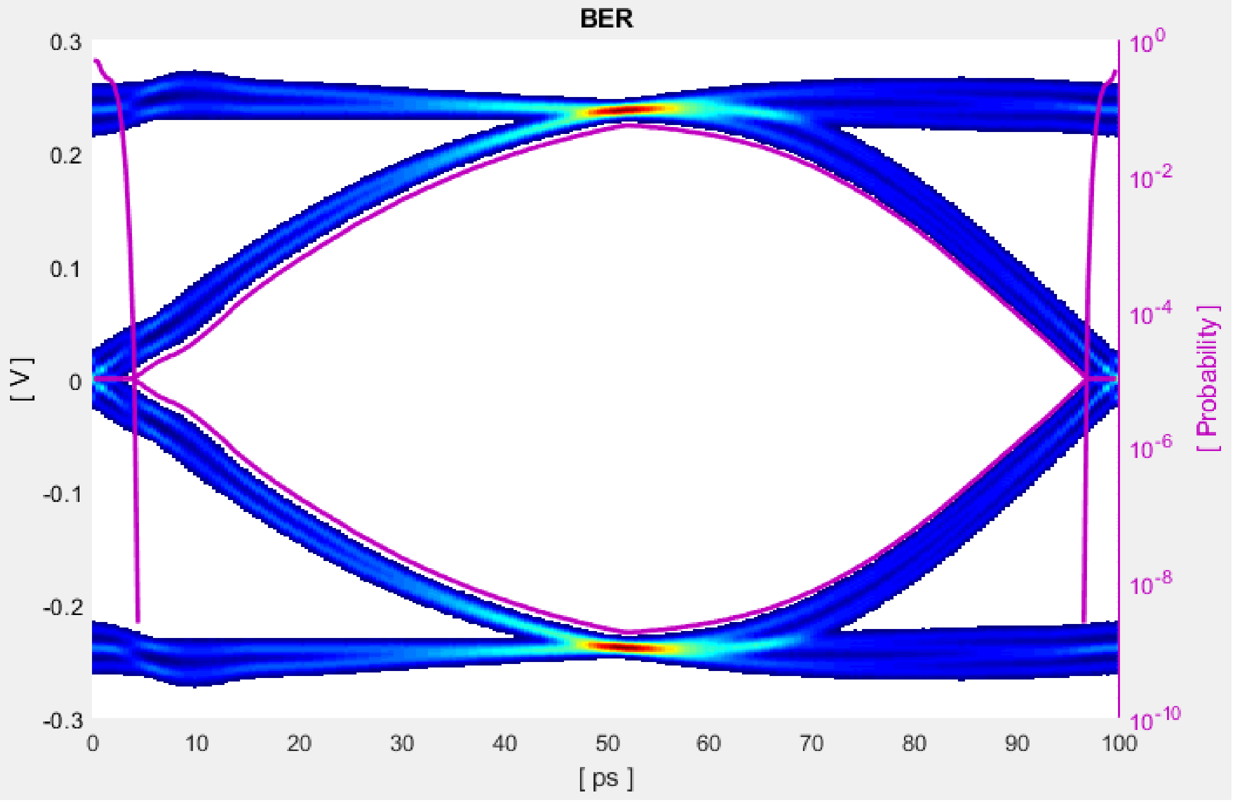
Perform Statistical Analysis

From the **ANALYSIS** tab in the app toolstrip, select **Add Plots** > **Pulse response** to display the pulse response of the SerDes system. You can zoom in to your area of interest where pulse equalization works.



Notice the difference in the pulse response before and after equalization.

Select **Add Plots > BER** to display the **Statistical Eye**, **Bathtub**, and **Contours** curve overlayed together in a single plot.



The eye diagram is used to determine the quality of signal integrity. An "open" eye indicates higher probability of bit recovery. The bathtub curve plots the bit error rate as a horizontal function of the data eye, and corresponds to eye-width. The contour curve plots the bit error rate as a vertical function of the data eye, and corresponds to eye-width.

Select **Add Plots > Report** to view the SerDes system report.

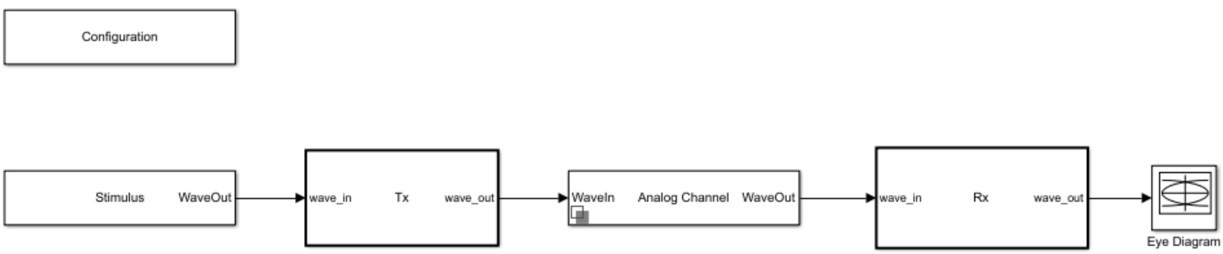
	Name	Data
1	Eye Height (V)	0.43559
2	Eye Width (ps)	92.9847
3		
4	CTLE:ConfigSelect	6
5		
6	DFECDR:TapWeights (V)	[0.0263 0.0184 -0.0021 -0.0044]

Notice that **CTLE ConfigSelect** and **DFECDR:TapWeights (V)** is determined by the optimization algorithm, since both CTLE and DFECDR blocks were in `adapt` **Mode**.

Export SerDes System to Simulink

From the **EXPORT** tab in the app toolstrip, click the **Export**

button to export the SerDes system to Simulink environment. The Simulink canvas contains a model that represents the SerDes system configured in the app.



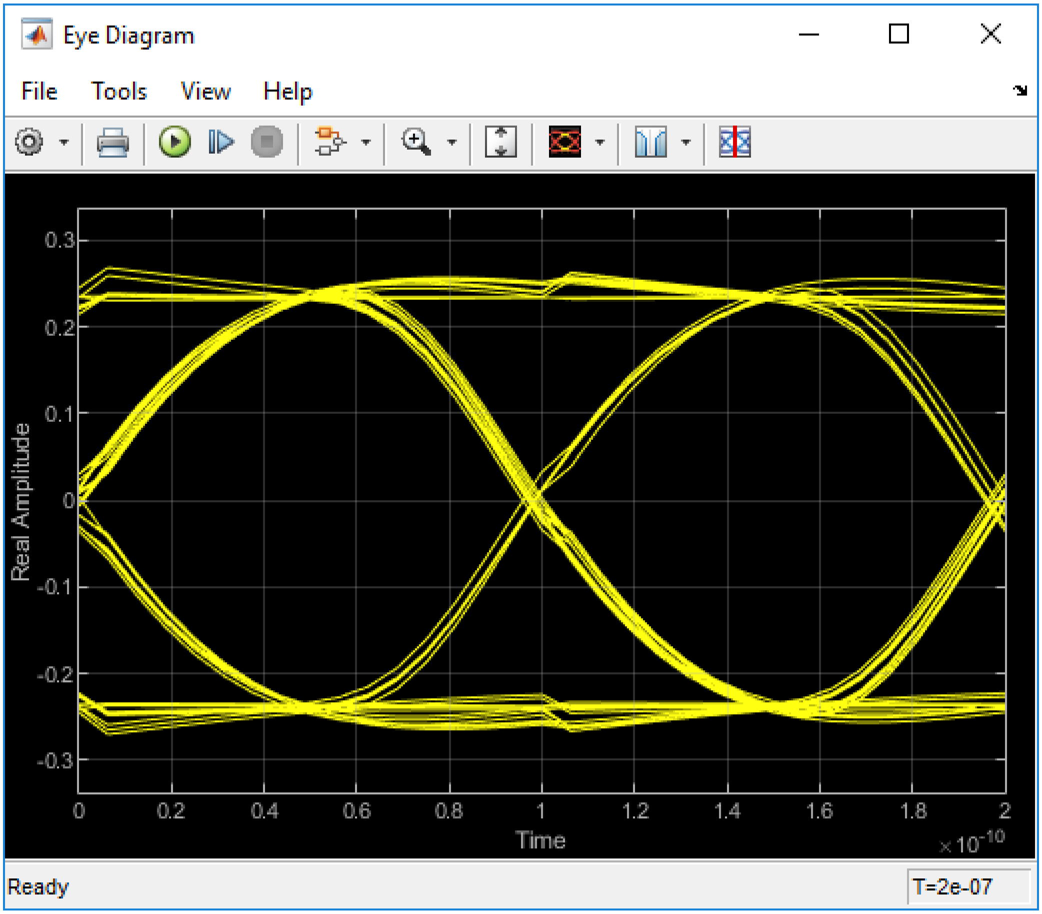
- Double click the Configuration block to open the Block Parameters dialog box. The parameter values for **Symbol time**, **Samples per symbol**, **Target BER**, **Modulation** and **Signaling** is carried over from the SerDes Designer app.
- Double click the Stimulus block to open the Block Parameters dialog box. You can set the **PRBS** (pseudorandom binary sequence) order and the number of symbols to simulate. This block is not carried over from the SerDes Designer app.
- Double click the Tx block to look inside the Tx subsystem. The subsystem has the FFE block carried over from the SerDes Designer app. An Init block is also introduced to

model the statistical portion of the AMI model. Double click the FFE block and notice that the parameter values for **Tap weights** is carried over from the app.

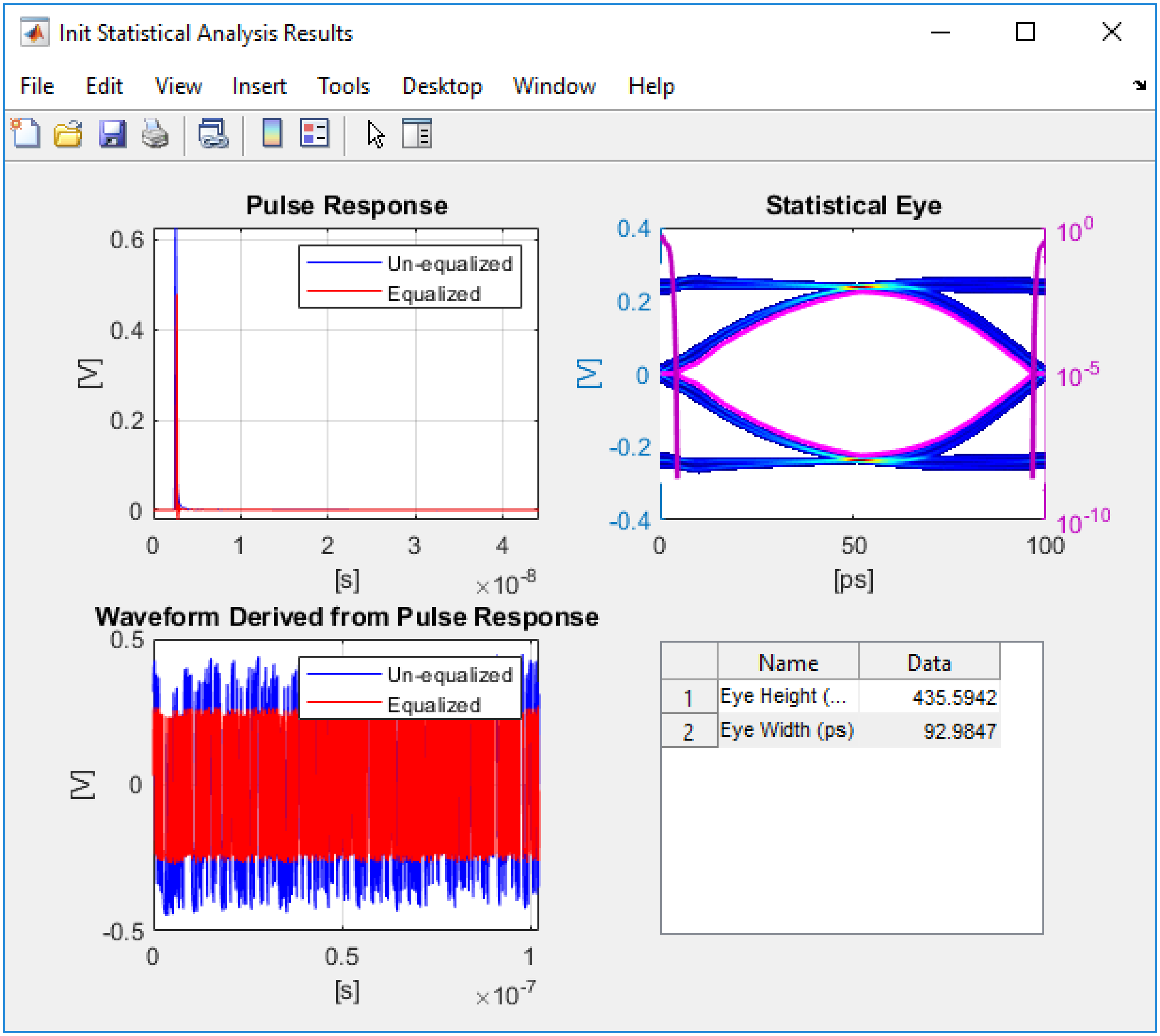
- Double click the Analog Channel block to open the Block Parameters dialog box. The parameter values for **Target frequency**, **Loss**, **Impedance** and Tx/Rx analog model parameters is carried over from the SerDes Designer app.
- Double click on the Rx block to look inside the Rx subsystem. The subsystem has the CTLE and DFECDR blocks carried over from the SerDes Designer app. An Init block is also introduced to model the statistical portion of the AMI model.

Run Simulation

Run the model to simulate the SerDes system. Two plots are generated. The first one is a live time domain eye diagram that is updated as the model is running.



The second plot contains four views of the statistical simulation results: the pulse response, statistical eye with bathtub and contours curve, output waveform derived from pulse response, and report including eye height and eye width.



Generate Tx/Rx IBIS-AMI Models

Open the Block Parameter dialog box for the Configuration block and click on the **Open SerDes IBIS/AMI Manager** button.

- In the **Export** tab, configure the models and files to be exported. **Corner percentage** scales the I-V and V-T curve data, voltage range and other IBIS data. **Model Settings** determines whether the exported model processes Init and GetWave data (Dual model), or only one.
- In the **IBIS** tab inside the SerDes IBIS/AMI manager dialog box, the analog model values are converted to standard IBIS parameters that can be used by any industry standard simulator.
- In the **AMI-Tx** and **AMI-Rx** tab in the SerDes IBIS/AMI manager dialog box, the reserved parameters are listed first followed by the model specific parameters following the format of a typical AMI file.

In the **Export** tab of the **SerDes IBIS-AMI Manager** parameter window, specify the target directory as `C:\Users\<user>\Desktop\DLL`, and click the **Export** button. In your desktop. inside a newly created `DLL` folder, you can fined the generated `serdes.ibs`, `serdes_rx.ami` and `serdes_tx.ami` files.

You can now test the IBIS-AMI models in standard AMI model simulator.