ANSYS SIwave R17: Near End and Far End Crosstalk Scanner

Crosstalk, or coupling, in high speed printed circuit board and packages represent one of main signal integrity design challenges. The cost of failure is very high and requires careful design strategies. This application note will introduce the capabilities for SIwave R17 to automatically, and quickly, scan the entire PCB or package layout and report Near and Far End crosstalk coefficients.

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Introduction

As electromagnetic simulation capabilities advance, so too does the need to accurately capture more fidelity in the models that are solved. Crosstalk is often a critical and serious design parameter of any PCB or package layout design. Failure to accurately design and minimize crosstalk could potentially yield to many signal or power integrity and EMI problems in future. Immediate design change would require fast analysis of identifying and verifying the impact of design changes.

In ANSYS Release 17, SIwave now allows for calculations of Crosstalk coefficients of all nets for the entire printed circuit board or package layout.

Crosstalk

When considering the effects of crosstalk on PCB design it is important to consider these factors: The degree of capacitive and inductive coupling between traces and the direction of the signals and the reflection of the backward coupled signal. There are two types of crosstalk: Far end and Near end crosstalk. Using the ANSYS SIwave R17 crosstalk scanner is quick way to detect signal line near and far end crosstalk violations. The crosstalk scanner will calculate crosstalk coefficients which are unitless values. The assumptions that are made for calculating crosstalk coefficients are: weak coupling between lines and routing lines are always terminated with match loads

Given two weakly coupled transmission lines characterized by inductance L and capacitance C parameters here are crosstalk coefficient formulas:

The Near End (**NEXT**) crosstalk coefficient is a unitless quatinty defined as:

$$K_{NEXT} = \frac{1}{2}\frac{1}{\sqrt{L11C11}+\sqrt{L22C22}}\left(\frac{L_{21}}{Z_1} - Z_2C_{21}\right)$$

The Far End (**FEXT**) crosstalk coefficient is defined in **ns/m** as:

$$K_{FEXT} = -\frac{1}{2}\frac{1}{tr,0}\left(\frac{L_{21}}{Z_1} - Z_2C_{21}\right)$$

Where $Z_1 = \sqrt{L_{11}/C_{11}}$ and $Z_2 = \sqrt{L_{22}/C_{22}}$ and $t_{r,0} = 1ns$

SIwave examines K_{NEXT} and K_{FEXT} for every homogenous sections of coupled lines. For every user defined victim section that couples to other sections, the maximum FEXT and NEXT coefficients are reported.

To run the crosstalk scan user would import layout of interest in SIwave and under Simulation select Crosstalk Scan. As a next step users would select the nets they want to include in the simulation. You can select any **Single Ended**, **Differential**, **Extended**, or **Extended Differential** net. To use regular expressions, enter the name of the nets you want to select in the Reg Ex field. Click Select Matching rows. Select the checkbox to include a net in the simulation for the **Scan Crosstalk.** User would enter values for the **Warning** and **Violation** thresholds for FEXT and NEXT.

Once the simulation is done, SIwave will automatically generate an HTML report with NEXT and FEXT coefficient results. These reports will contain any warnings, violations, layer of violation, routing type, and length of longest violation section in mm. An example of Crosstalk HTML report is shown below.

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ANSYS SIwave 2016.0.0 (solver build: Nov 9 2015 Win64) Host Name: SJO7N4DSOLDO

NEXT coefficient

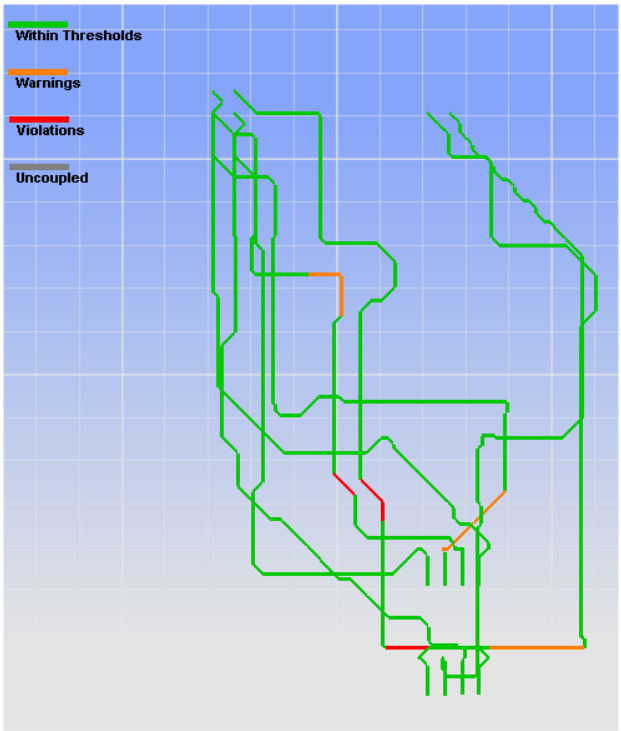
Net Name	NEXT Warning Tolerance	NEXT Violation Tolerance	SE or Diff	Cross Section Type	Violation	Layer of Violation	Max NEXT	Length of Max NEXT (mm)	NEXT of Longest Line Section	Length of Longest Line Section (mm)
DDR_D0	0.003	0.004	SE	MSL; STL	Yes	"TOP"	0.005	4.445	0.005	4.445
DDR_D1	0.003	0.004	SE	MSL; STL	Warning		0.004	1.201	0.004	1.201
DDR_D2	0.003	0.004	SE	MSL; STL	No		0.000	5.405	0.000	5.405
DDR_D3	0.003	0.004	SE	MSL; STL	No		0.002	2.371	0.000	7.842
DDR_D4	0.003	0.004	SE	MSL; STL	No		0.000	5.652	0.000	5.652
DDR_D5	0.003	0.004	SE	MSL; STL	No		0.001	4.178	0.000	7.595
DDR_D6	0.003	0.004	SE	MSL; STL	No		0.003	1.353	0.000	7.478
DDR_D7	0.003	0.004	SE	MSL; STL	No		0.000	1.599	0.000	6.395

FEXT coefficient

Net Name	FEXT Warning Tolerance (ns/m)	FEXT Violation Tolerance (ns/m)	SE or Diff	Cross Section Type	Violation	Layer of Violation	Max FEXT (ns/m)	Length of Max FEXT (mm)	FEXT of Longest Line Section (ns/m)	Length of Longest Line Section (mm)
DDR_D3	0.003	0.005	SE	MSL; STL	Yes	"BOTTOM"	0.010	2.371	0.010	2.371
DDR_D6	0.003	0.005	SE	MSL; STL	Yes	"BOTTOM"	0.018	1.353	0.018	1.353
DDR_D0	0.003	0.005	SE	MSL; STL	Warning		0.004	4.445	0.004	4.445
DDR_D5	0.003	0.005	SE	MSL; STL	Warning		0.004	4.178	0.004	4.178
DDR_D1	0.003	0.005	SE	MSL; STL	No		0.001	1.201	0.000	11.582
DDR_D2	0.003	0.005	SE	MSL; STL	No		0.000	5.405	0.000	5.405
DDR_D4	0.003	0.005	SE	MSL; STL	No		0.000	5.652	0.000	5.652
DDR_D7	0.003	0.005	SE	MSL; STL	No		0.000	4.191	0.000	6.395

A user can also view Crosstalk results in the UI and display all warning and violations for Near and Far end crosstalk coefficients.

Near End



Far End