Simbeor THz

Electromagnetic Signal Integrity Software to Design Predictable PCB/Packaging Interconnects

New in Simbeor 2020:

- ***Simbeor SDK with API for all tools and solvers in C / C++ / Matlab / Python…***
- *Improvements in Board Analyzer, TLine Wizard and Via Analyzer - demo #*
- *TLS1.2 compliant communication with Agents*
- *PML in 3DTF solver for infinite plane conditions*
- *See details in What is new in Simbeor 2020…*

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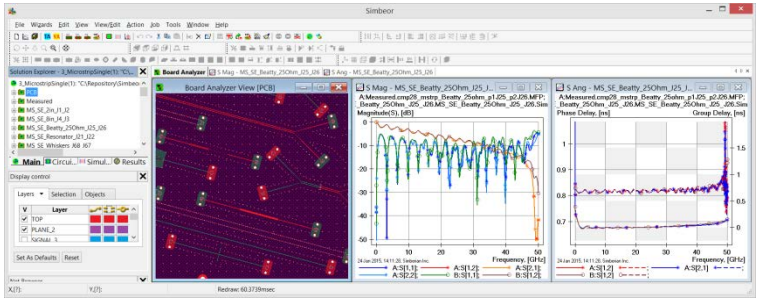


Simbeor SDK 2020

Signal Integrity Analysis Automation Kit for Machine Learning and Design Automation Applications

Includes APIs in C/Matlab/Python for all Simbeor solvers and pre-layout tools

First Released November 2019

Updated on December 21, 2019

What is Simbeor SDK?

- Simbeor SDK is dynamic link libraries with API in C language for programming or scripting in C/C++, Matlab and Python
- It provides access to all Simbeor solvers and all pre-layout tools and can be used for…
  - **Signal integrity analysis automation** – scripted EM analysis, geometry synthesis, complete link analysis, material model identification…
  - **Machine learning** – training or complimenting machine learning algorithms, populating solution space with the signal integrity analysis automation…
  - **Integrating into your EDA tools** (Stack Manager in Altium Designer 19-20)

Simbeor SDK: Getting started

- See introductory demo-video https://www.simberian.com/ScreenCasts.php?id=63
- Download Simbeor SDK installer from the Software/Downloads section and install it
  - By default Simbeor SDK is installed into "..\Program Files\Simberian\Simbeor THz 2020\sdk"
  - It contains the main dll module in ..\bin, lib file in ..\lib, pyd file is with the python examples
  - Include files are located in ..\include sub-directory - they are extensively self-documented.
  - For convenience, the installer adds SIMBEOR_SDK environment variable that points at the ..\sdk directory (use it to access includes, lib and dll).
- Examples of Simbeor SDK use are provided in C/C++, Matlab and Python
  - By default installed to Documents\Simbeor SDK Examples
  - To open the cpp example solution, use Microsoft Visual Studio 2017 or later with C++ compiler
  - Microsoft Visual Studio C++ compiler is also required for Matlab examples
  - For scripting in Python, use Python 3.7 available at https://www.python.org/downloads/
  - Follow comments in the examples and specify the license location and type, path to files used in tests and where to put the results
  - Simbeor SDK can use your existing Simbeor license (network or node-locked) with solvers and tools included in the license - if no license, request free 15-day license

How to start learning and using SDK

- C – all header files are self-documented, examples for use of all functions is provided in test_sdk.cpp, read introductory document sdk_cpp_matlab_help.pdf
- Matlab
  - All header files are self-documented – description is also available at http://kb.simberian.com/SimbeorSDKCMatlab.php
  - Start with TLineKit for t-line analysis and proceed with MLKit (simple and realistic link analysis automation for Machine Learning) – see C2C_LinkParameters.docx
- Python
  - http://kb.simberian.com/SimbeorSDKPython.php or pdf available at http://kb.simberian.com/
  - Go through examples provided with installer

Simbeor SDK: Problems to solve

- PCB/Packaging transmission line synthesis, analysis, sweeps (stackup planning, SFS)
  - test_zcalc -> testZCalc, test_tlsweeps -> testParameterizedTLineSweeps
- Building advanced multi-conductor transmission line models (crosstalk, impedance, losses vs. frequency)
  - test_zcalc -> testTLineModels (SFS), test_tla -> testTLineModelsAdv (SFS, 3DML, 3DTF)
- Building models for transmission lines with periodic discontinuities (meshed planes, BGA areas,…)
  - test_periodic -> testPeriodicStructures (3DML or 3DTF)
- Evaluation of multiport S-parameter model quality, compliance metrics, building rational compact and BB SPICE models (LAPLACE or FOSTER) for multiports (everything for S-parameters)
  - test_mpt -> testMultiportModels (Model File Processor, Rational Compactor)
- Complete link analysis in frequency and in time domain with building rational compact and BB SPICE models (losses, reflections, crosstalk, compliance metrics, TDR/TDT, eye diagrams)
  - test_lns -> testLinearNetworkElements, test_random -> testStatisticalLinkModels (Linear Network Solver, Rational Compactor)
- Identification of dielectric models (11) and conductor roughness models (7) with GMS-parameters, SPP Light and Gamma-T methods (LNS, SFS, SITune, TResonator Analyzer)
  - test_gms -> testMaterialModelIdentificationGMS, testMaterialModelIdentificationSPP, testMaterialModelIdentificationDiffSPP, testMaterialModelIdentificationDiffSPP_EvenAndOdd, test_tra -> testTResonatorAnalyzer
- Computation of eye diagram and comparison of eyes (Eye Analyzer): test_eye -> testEyeAnalyzer
- **Many more examples – open C++ examples called from test_sdk.cpp or in Python and Matlab directories**

Modeling of T-Lines with Simbeor SFS

- Advanced quasi-static field solver based on Method of Moments (MoM) – **available in Simbeor SDK 2018**
- Takes geometry of traces in layered media (rectangular trapezoidal, hat-shape, butterfly or hexagonal trace shape) and realistic conformal solder mask defined by 2 parameters
- Traces can be in signal as well as in plane layers (conformal metallization)
- Accounts for the dispersion in dielectrics (11 dielectric models), conductor skin-effect and skin-effect on rough surface (7 unified multi-level roughness models defined with 2 parameters per level)
- Can be used to identify single-ended and differential trace width/spacing for a given impedance (synthesis) or compute characteristic impedance, delay and attenuation at a given frequency (analysis)
- Computes frequency-dependent modal, RLGC and S-parameters to evaluate delay, losses and cross-talk
- Outputs tabulated W-element – frequency-dependent R, L, G and C matrices in HSPICE-compatible format
- Covers all configurations in Polar tools and much more with more advanced algorithms and higher accuracy!

see Simbeor SDK -> sdk_cpp_matlab_help.pdf and TLineKit and docs in MLKit

Simbeor 3DML

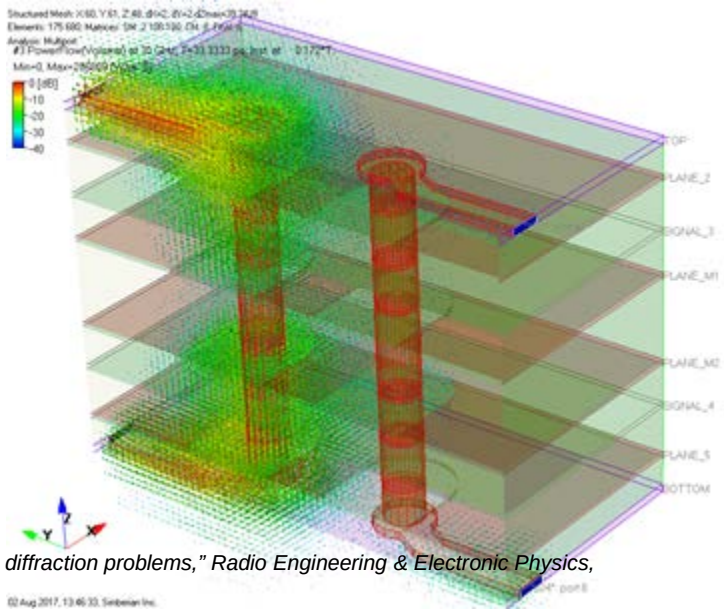
- Full-wave 3D analysis tool for multi-layered geometries (planar 3D)
- Faster analysis of smaller structures with high accuracy
- Hybrid solver:
  - Method of Lines – similar to Method of Moments
  - Trefftz Finite Elements are used inside conductors
  - Method of Simultaneous Diagonalization used for precise de-embedding
- Analysis of discontinuities and transmission lines with high-frequency (non-TEM) dispersion and anisotropy (any planar cross-section), interconnects with meshed planes
- **Available in Simbeor SDK 2020 for analysis of any 3D multi-layered geometry**

Y.O. Shlepnev, "Extension of th Method of Lines for planar 3D structures" - in Proceedings of the 15th Annual Review of Progress in Applied Computational Electromagnetics (ACES'99), Monterey, CA, 1999, p.116-121.

Simbeor 3DTF

- 3D full-wave solver based on unique Trefftz finite element method (should not be confuse with Ultra week Discontinuous Galerkin Wave Elements)
- Analysis of discontinuities, transmission lines and periodic structures
- Unique field visualization capability (E, H, currents, **power flow density**,…)
- Current version uses structural adaptive mesh – it restricts complexity of geometry
- Theory of hexahedral elements and adaptive elements is developed and tested in prototype
- Potential applications: advanced power and signal integrity (1D+2D+3D), connectors, packaging, THz interconnects,…
- **Available in Simbeor SDK 2020 for analysis of any 3D multi-layered geometry with possible 3D objects**

Power flow density in coupled differential vias computed with Simbeor 3DTF



1. V.V. Nikol'skii, T.I. Lavrova, "The method of minimum autonomous blocks and its application to waveguide diffraction problems," Radio Engineering & Electronic Physics, vol. 23, no. 2, p.1-10, 1978.

2. V.V. Nikol'skii, T.I. Nikol'skaia, Decompositional approach to electromagnetic problems. Moscow: Nauka, 1983 (in Russian).

3. Y.O. Shlepnev, Trefftz finite elements for electromagnetics. - IEEE Trans. on Microwave Theory and Techniques, vol. MTT-50, pp. 1328-1339, May, 2002.

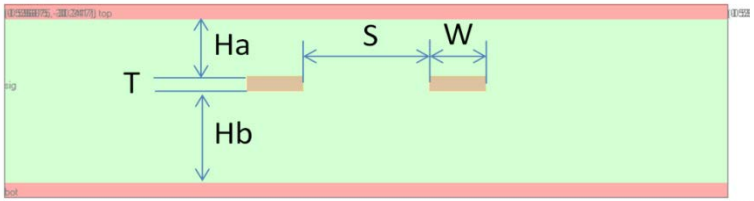
Analysis of networks with S-parameters

- Simbeor Multiport File Processor – **available in Simbeor SDK 2018**
  - Everything for S-parameter models in Touchstone format – reading, writing, all types of conversions, post-processing, quality evaluation
  - Conversion into rational macro-model (unique passive vectfit) and into Broadband SPICE macro-models (LAPLACE or FOSTER)
- Simbeor Linear Network Solver – **available in Simbeor SDK 2018**
  - Everything needed for frequency (AC) and time-domain (TD) analysis of networks composed of S-parameter models, transmission line segments, discontinuities (models built in Simbeor or other tools) and package models (RLGC circuits)
  - TD analysis includes simple models for transmitters and receivers (step, pulse, bit streams with jitter sources, terminators)
  - Computes S-parameters or pulse response for external IBIS-AMI or COM analysis
  - Recursive convolution can be used with an external SPICE solver for analysis with IBIS or SPICE models for transmitters and receivers

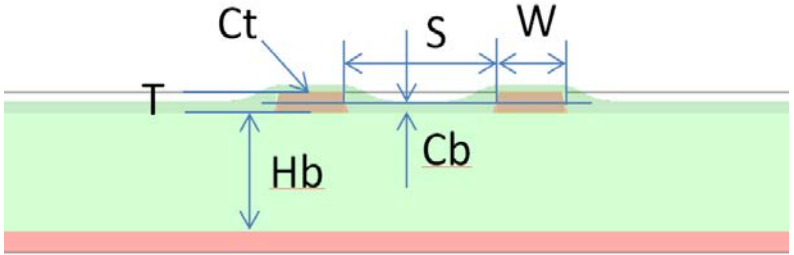
MLKit – examples of SDK use in Matlab

Simple links – for impedance and losses investigation

testSimpleStripLink.m



testSimpleMicrostripLink.m

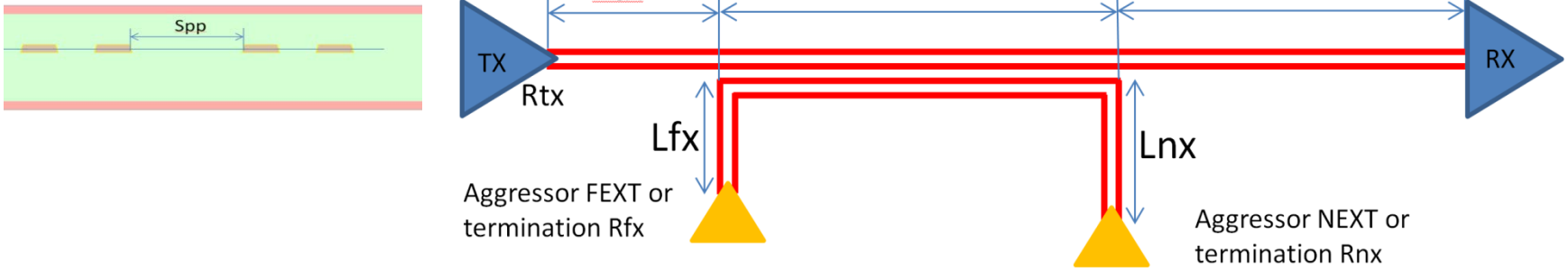


Defines geometry of a link with simple data structures -> Outputs S-parameter file suitable for compliance analysis with Ethernet 100G COM scripts

MLKit – examples of SDK use in Matlab

Links with crosstalk – for losses and couplings investigations

Coupled strip link example: testCoupledStripLink.m
Coupled microstrip link example testCoupledMicrostripLink.m

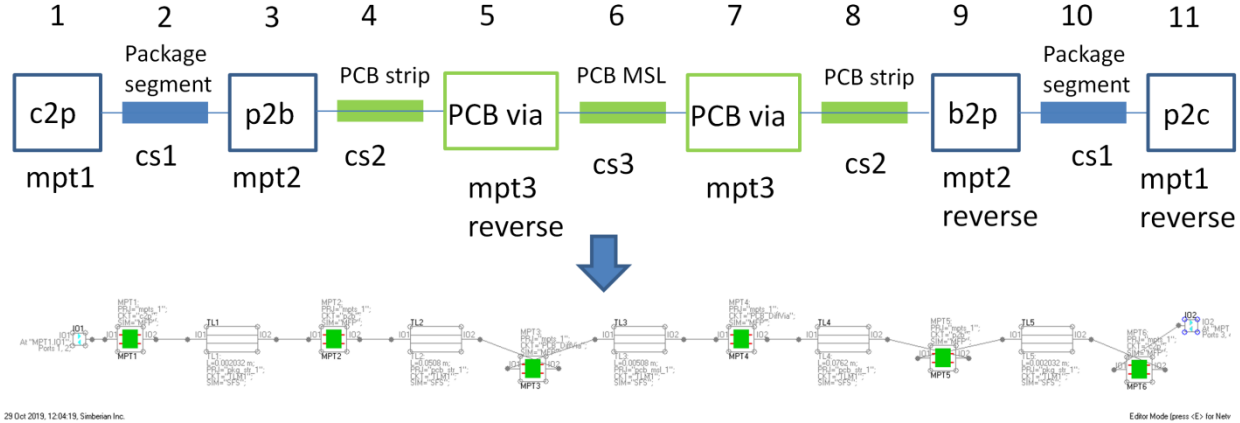


Defines geometry of a link with crosstalk with simple data structures -> Outputs 4 S-parameter files (complete, through, next, fext) suitable for compliance analysis with Ethernet 100G COM scripts

MLKit – examples of SDK use in Matlab

Differential multi-segment chip to chip link with discontinuities – for losses and reflections investigations

testMultiSegmentLink.m

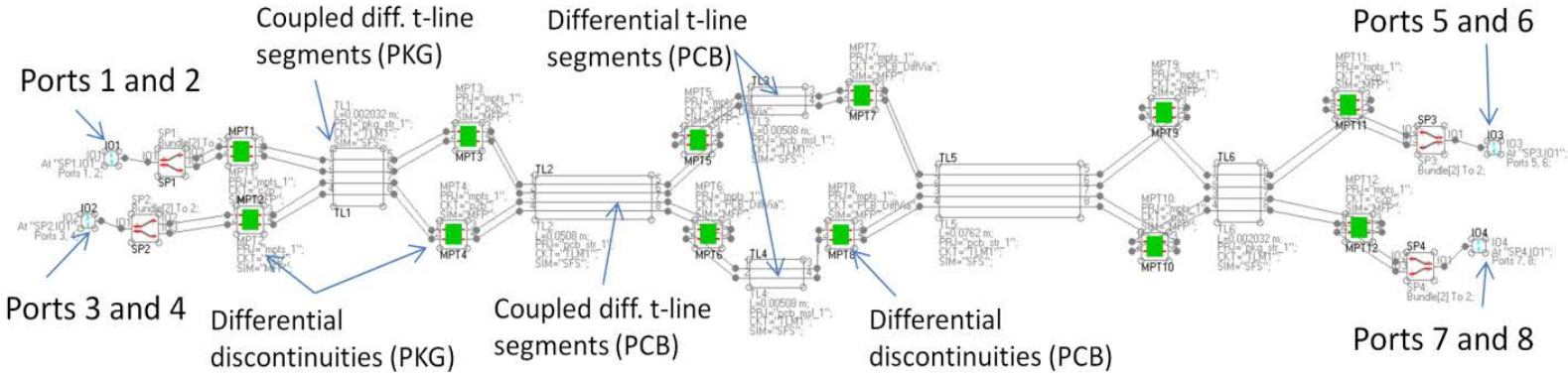


Defines geometry of a link with reflections with simple data structures -> Outputs 4 S-parameter files (complete, through, next, fext) suitable for compliance analysis with Ethernet 100G COM scripts

MLKit – examples of SDK use in Matlab

Differential multi-segment chip to chip link with discontinuities and crosstalk – for losses, reflections and couplings investigations

testMultiSegmentCoupledLink.m



Defines geometry of a link with crosstalk with simple data structures -> Outputs 4 S-parameter files (complete, through, next, fext) suitable for compliance analysis with Ethernet 100G COM scripts

Why use Simbeor SDK?

1. Algorithms are systematically and independently validated with measurements up to 50 GHz!
2. Unique algorithms for material models identification – must be the basis of systematic approach to design predictable interconnects
3. Advanced and verifiably accurate models of transmission lines
4. Unique EM models for flexible interconnects and periodic structures
5. Unique macro-modeling capabilities for consistent FD and TD analyses of networks with t-lines and S-parameter models
6. Unique de-embedding capabilities (part of LNS)

Automate your signal integrity tasks or build your own apps with Simbeor SDK!

What is next?

Download Simbeor SDK 2020 from
www.simberian.com/Downloads.php

And request your term or trial license