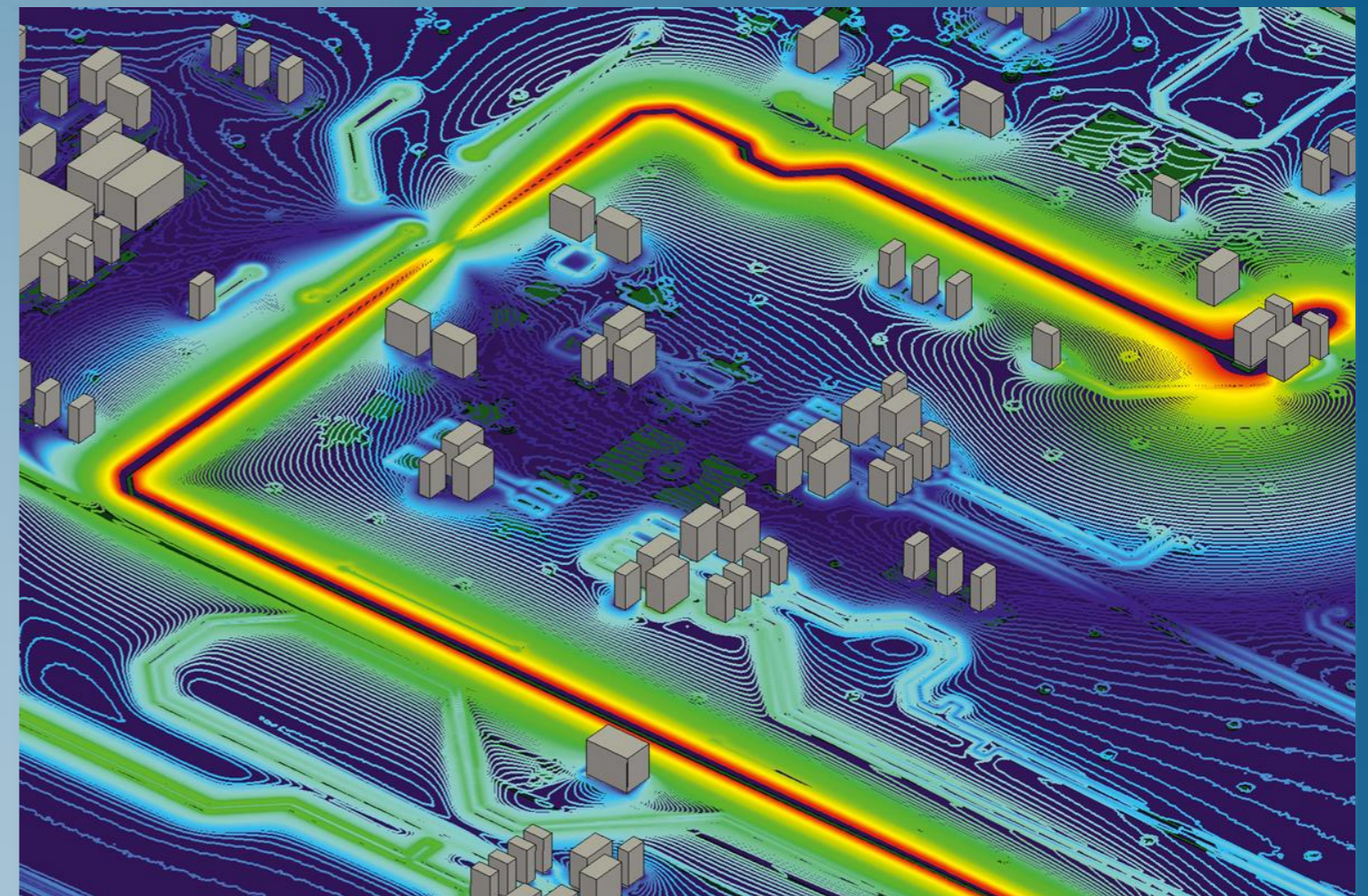


# CST Studio Suite - EMC/EMI

2020



**3DEXPERIENCE**<sup>®</sup>



# About this Course

## Course objectives

The EMC Module expands upon the CORE Module basics to provide an overview on how simulation can be applied towards electromagnetic compatibility (EMC) design and analysis. Upon completion, you will understand the different solvers, sources and outputs for EMC simulation, and you will be able to set up simulations for emissions and immunity, shielding effectiveness, 3D EM and circuit co-simulations, and cable modeling.

## Targeted audience

This course is intended for engineers involved in electromagnetic compatibility (EMC), electromagnetic interference (EMI), electrostatic discharge (ESD), electromagnetic environmental effects (E3) and antenna integration.

## Prerequisites

Introduction to CST Studio Suite



1 day

# Day 1

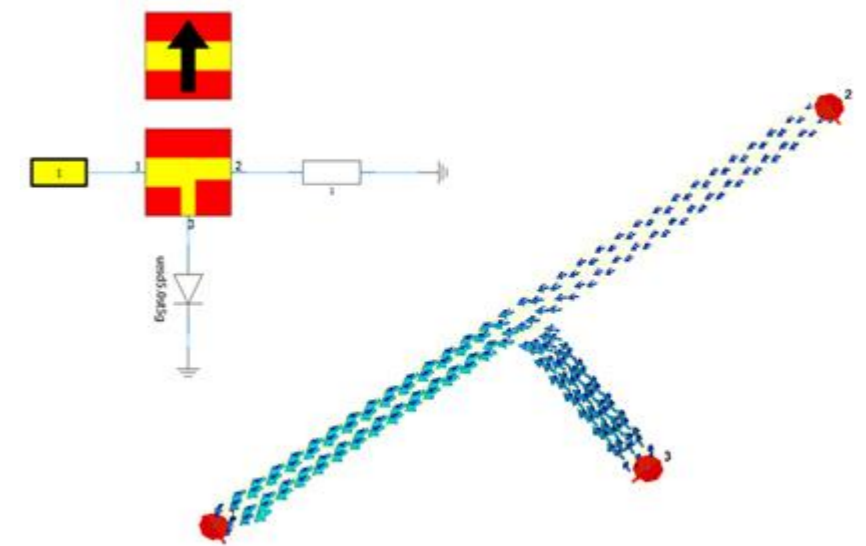
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- ▶ Lesson 1: Introduction, Solver Choice for EMC Applications
  - Configuration Wizard (hands on)
  
- ▶ Lesson 2: Meshing Overview
  
- ▶ Lesson 3: CST DESIGN STUDIO – Circuit and System Level Simulations
- ▶ Workshop 1: True Transient Co-Simulation
  
- ▶ Lesson 4: Sources and Outputs for EMC Simulation
- ▶ Workshop 2: Choose one of the remaining workshops provided with this course
  
- ▶ Lesson 5: EDA Import
  
- ▶ Lesson 6: CST CABLE STUDIO – Introduction and Workflow Overview
- ▶ Workshop 3: Choose one of the remaining workshops provided with this course

## Workshop Examples (1/3)

### ► True Transient Co-simulation

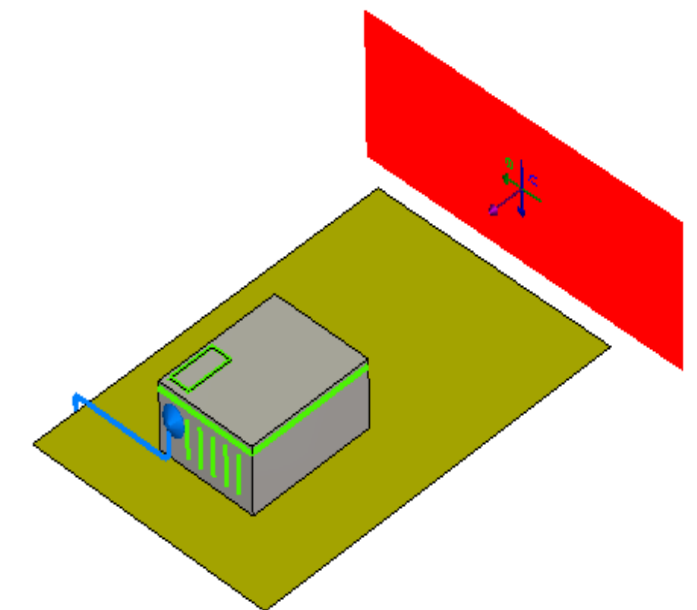
- Transient Circuit Simulation
- System Assembly Modeling
- Transient Co-Simulation with MWS & DES



Depending on your background choose two workshops from the following seven to execute during this course. Extract the files from the zip archive to your working directory.

### ► Panel Shielding Effectiveness

- Transient Solver TLM
- Compact Models
- System Assembly Modeling
- Near Field Source (NFS)



## Workshop Examples (2/3)

### ▶ **Lightning Strike Simulation**

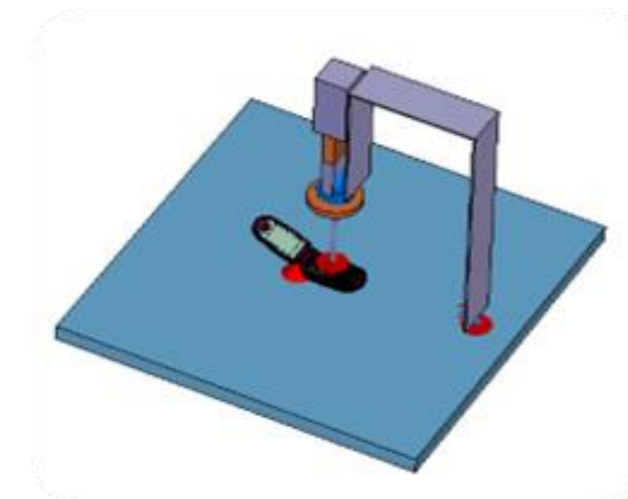
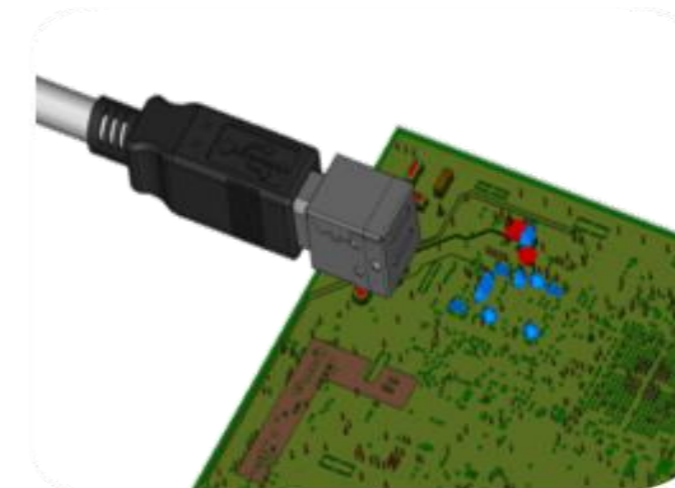
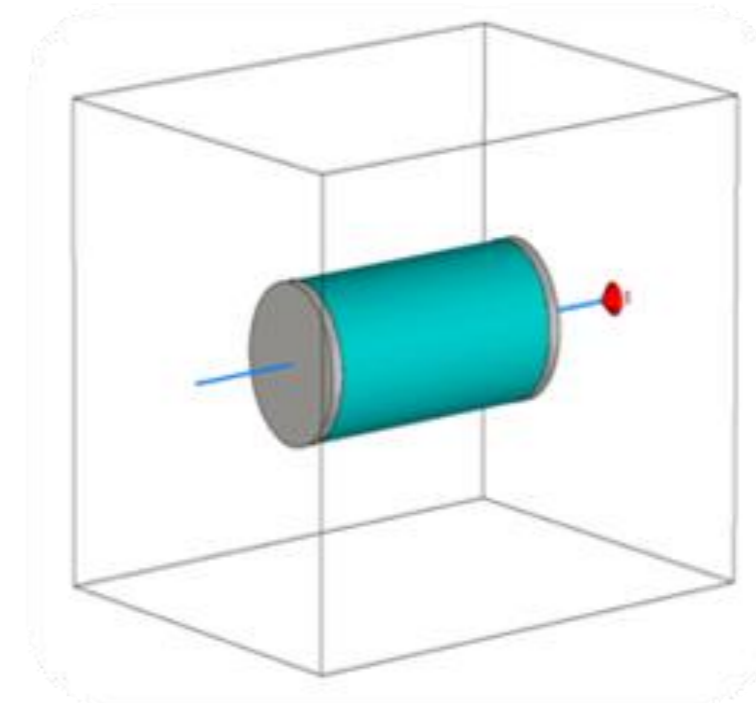
- Transient Solver TLM
- Compact Models and Special Materials
- Lightning Strike Signal Definition

### ▶ **Emissions Simulation via Cascading** PCB, Connector, Cable

- Transient Solver FIT
- Co-Simulation with DES
- Calculation of Common Mode

### ▶ **Electrostatic Discharge (ESD)**

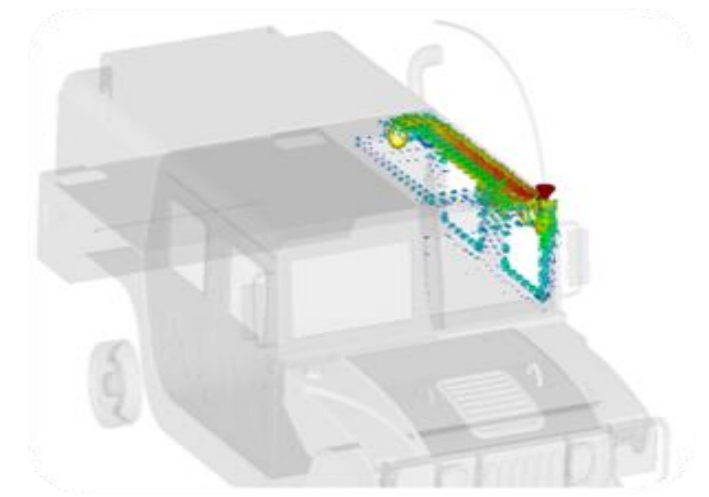
- Transient Solver FIT or TLM
- Details of Gun Model
- Import and Alignment of CAD Data
- True Transient Co-Simulation



## Workshop Examples (3/3)

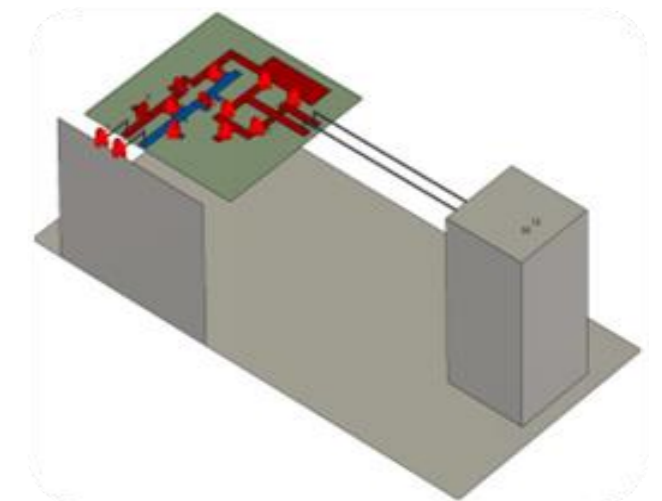
### ► CST CABLE STUDIO

- Crosstalk Simulation
- Common Impedance Coupling Simulation
- Crosstalk Simulation in Shielded Cables
- EM Susceptibility – Field Coupling into Cables



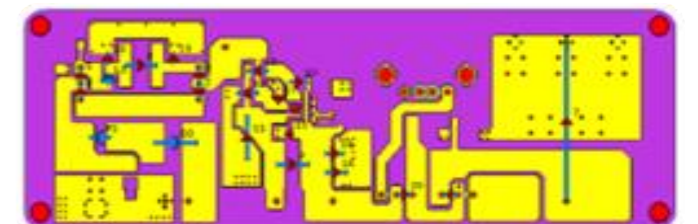
### ► Motor Control

- Conducted Emission
- Frequency Domain Solver
- Traditional Co-Simulation:  
Tuning of a Lumped Element EMI Filter, Inclusion of 3D Layout Effects



### ► DC-DC Converter

- Conducted Emission
- Frequency Domain Solver
- EDA Import
- Traditional Co-Simulation:  
Tuning of a Lumped Element EMI Filter, Inclusion of 3D Layout Effects



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The screenshot shows the SIMULIA Services Training Courses page. At the top, there is a navigation menu with the following items: PRODUCTS & SERVICES, SIMULIA, SERVICES, TRAINING COURSES, and SCHEDULE & REGISTRATION. Below the navigation, the main heading is "SIMULIA SERVICES" with the subtext "PROVIDING HIGH QUALITY SIMULATION AND TRAINING SERVICES TO ENABLE OUR CUSTOMERS TO BE MORE PRODUCTIVE AND COMPETITIVE." A teal button labeled "CONTACT SALES" with an envelope icon is positioned in the top right. The section "Training Schedule & Registration" contains a paragraph explaining the availability of seminars and courses. Below this, there are three columns: "North American" with a map of North America, "International" with a globe, and "Live Online Training" with a computer monitor icon. Each column has two links: "By Location" and "By Course" for the first two, and "Full Schedule" for the third.

PRODUCTS & SERVICES ▾ SIMULIA ▾ SERVICES ▾ TRAINING COURSES ▾ SCHEDULE & REGISTRATION ▾

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### Training Schedule & Registration


We offer regularly scheduled public seminars as well as training courses at customer sites. An extensive range of courses are available, ranging from basic introductions to advanced courses that cover specific analysis topics and applications. On-site courses can be customized to focus on topics of particular interest to the customer, based on the customer's prior specification. To view the worldwide course schedule and to register for a course, visit the links below.

#### North American




- > [By Location](#)
- > [By Course](#)

#### International



- > [By Location](#)
- > [By Course](#)

#### Live Online Training



- > [Full Schedule](#)

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# Revision Status

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<b>Lesson 1</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
<b>Lesson 2</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
<b>Lesson 3</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
<b>Lesson 4</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
<b>Lesson 5</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
<b>Lesson 6</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
<b>Workshop 1</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
<b>Workshop 2</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
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<b>Workshop 5</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
<b>Workshop 6</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
<b>Workshop 7</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>
<b>Workshop 8</b>	<b>1/20</b>	<b>Updated for CST Studio 2020</b>

# Lesson 1: Solver Choice for EMC Applications

## *Lesson content:*

- ▶ Time Domain and Frequency Domain methods
  - ▶ Pros and Cons for EMC simulation
- ▶ Specialized Solvers
  - ▶ CST Cable Studio (CST CS)
  - ▶ CST Design Studio (CST DES)
- ▶ Configuration Wizard
  - ▶ Configuration Wizard Hands On



20 minutes

# Lesson 2: Meshing Overview

## ***Lesson content:***

- ▶ How to Get a Good Mesh?
- ▶ Mesh Types
- ▶ Hexahedral Meshing for Time Domain Simulations
- ▶ Tetrahedral and Surface Meshing for Frequency Domain Simulations



# Lesson 3: CST Design Studio (CST DES)

## ***Lesson content:***

- ▶ Lumped Component Modeling
- ▶ Co-Simulation Types
- ▶ Components Directly in CST MWS
- ▶ Component Definition in CST Design Studio
- ▶ Blocks in CST Design Studio
- ▶ Simulation Tasks in CST Design Studio
- ▶ Workshop 1: True Transient Co-Simulation



40 minutes

# Workshop 1: True Transient Co-Simulation

**Task:** Visualize the current flow when a protection diode is attached to a microstrip

The aim of this workshop is to set up a True Transient Co-Simulation with CST DES and CST MWS. You will create a 3D model from the circuit layer using System Assembly Modeling (SAM).

Things to know about the co-simulation type True Transient:

- ▶ Unique feature to CST. Used with 3D transient solvers.
- ▶ Time stepping is performed on the circuit and 3D level simultaneously.
- ▶ Can include nonlinear elements in the 3D simulation.
- ▶ Allows field visualization with included nonlinear elements in the 3D simulation.
- ▶ Very powerful for certain application classes.
- ▶ Useful when many internal ports need to be considered.



20 minutes

# Lesson 4: Overview of Sources/Outputs for EMC Simulation

## ***Lesson content:***

- ▶ Sources: Plane Wave
- ▶ Plane Wave: Decoupling Plane
- ▶ Sources: Field Source
- ▶ Field Source Workflow for Emissions
- ▶ Test Case: Peak Radiated Field Comparison
- ▶ Field Sources Workflow for E3
- ▶ Cable Radiation Sources (CST Cable Studio)
- ▶ General Outputs
  - Field Probes
  - Voltage and Current Monitors
  - Field Monitors
  - 3D Field Display
  - Farfield Monitor
  - Farfield Display
  - Cylinder Scan



# Lesson 5: EDA Workflow Integration – CST MWS

## ***Lesson content:***

- ▶ EDA Data Import in CST Microwave Studio
- ▶ Stackup Editor
- ▶ Components and Parts Import
- ▶ Customize Selection
- ▶ Automatic / Manual Port Definition
- ▶ Special Settings
  - Substrate Layers
  - Ports
  - Automatic Mesh Settings
  - Fully Automatic Cleaning and Healing Procedure

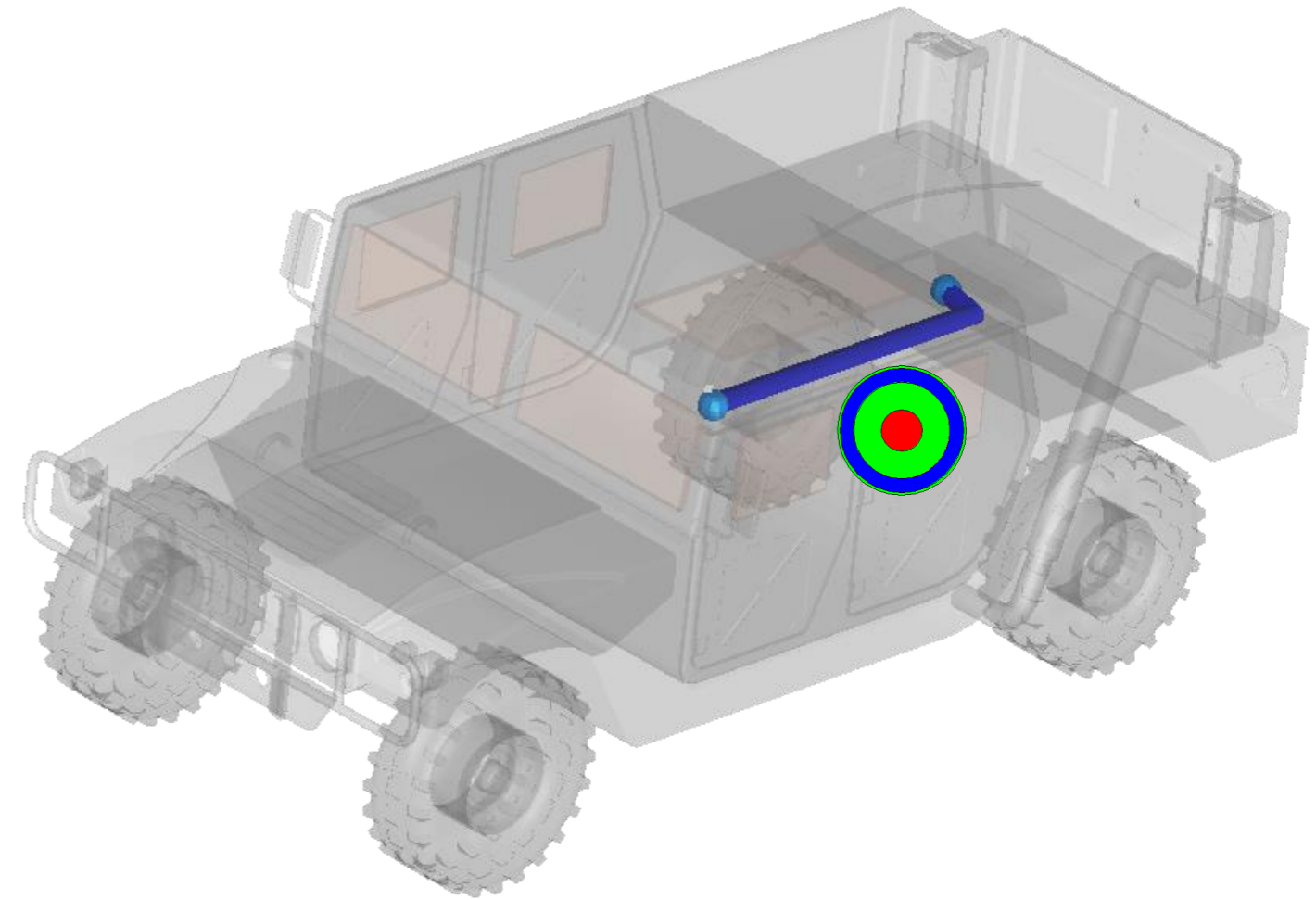


20 minutes

# Lesson 6: Introduction to CST Cable Studio

## ***Lesson content:***

- ▶ What is CST Cable Studio?
- ▶ Graphical User Interface (GUI)
- ▶ Cables Ribbon
- ▶ The Cable Navigation Tree
- ▶ CST Cable Studio Workflow
  - 2D (TL) Modeling
  - Impedance Calculator
  - Circuit modeling aspects
- ▶ Field Coupled Workflows
- ▶ How to Create a Cable bundle



# Workshop 2: Simulating Shielding Effectiveness

Task: Find shielding effectiveness of panel and enclosure  
Keywords: TLM Solver, compact modeling, System Assembly and Modeling (SAM)

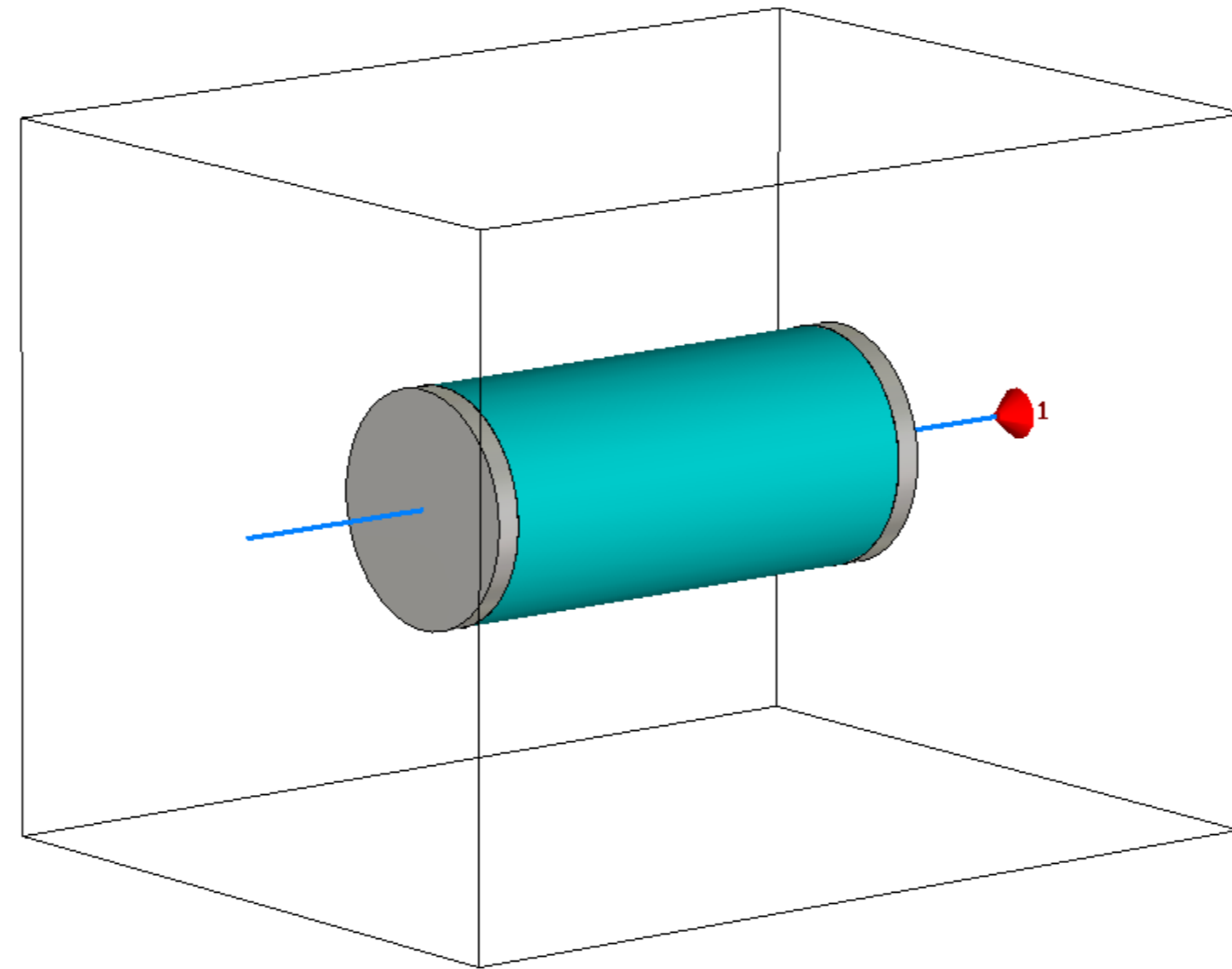
The aim of this section is to introduce shielding effectiveness (SE) and compact modeling. Simulating SE of panels with lossy metal, thin film, slot, vent, wire and enclosure SE with internal and external source through SAM workflow.



# Workshop 3: Lightning Strike Analysis

Task: Assess the susceptibility of a shielded cable inside a graphite test cylinder

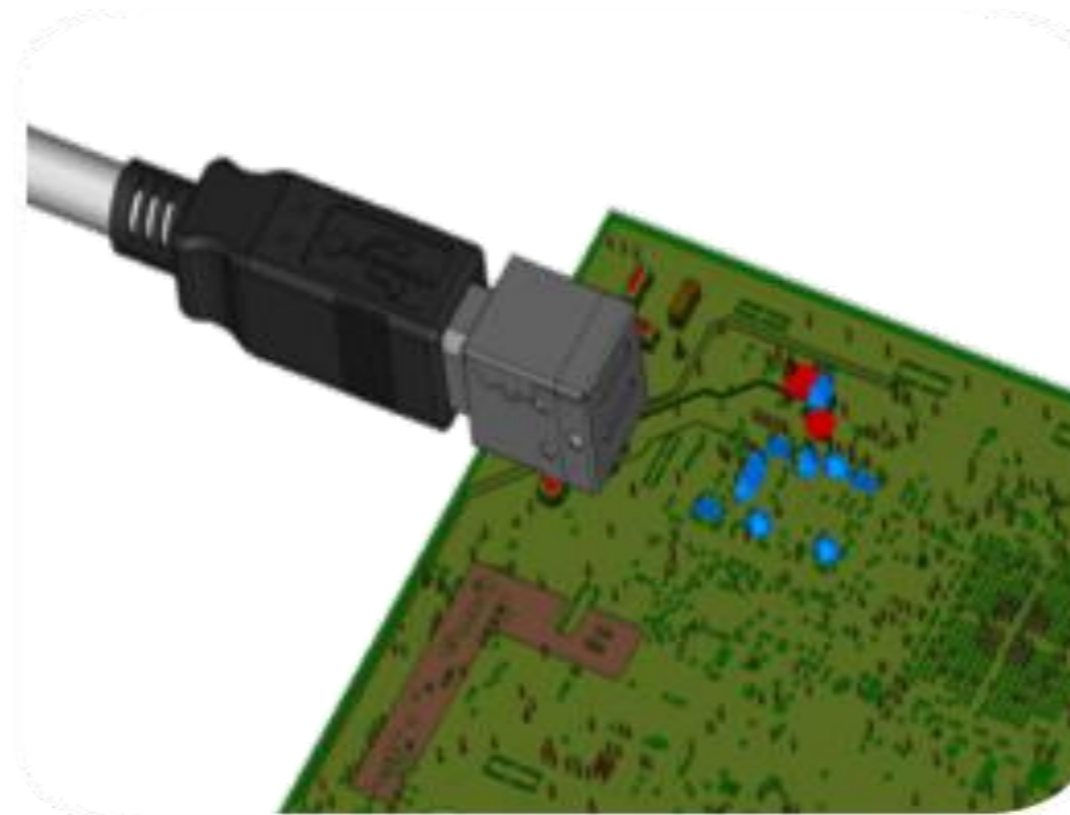
Keywords: Lightning Strike, Transient, TLM Solver, Thin Panel, Shielded Cable Material Type



# Workshop 4: Emissions Simulation via Cascading

Task: Cascade PCB/connector equivalent circuit model with model of shielded cable, model effect of driver skew and common mode choke on radiated emissions

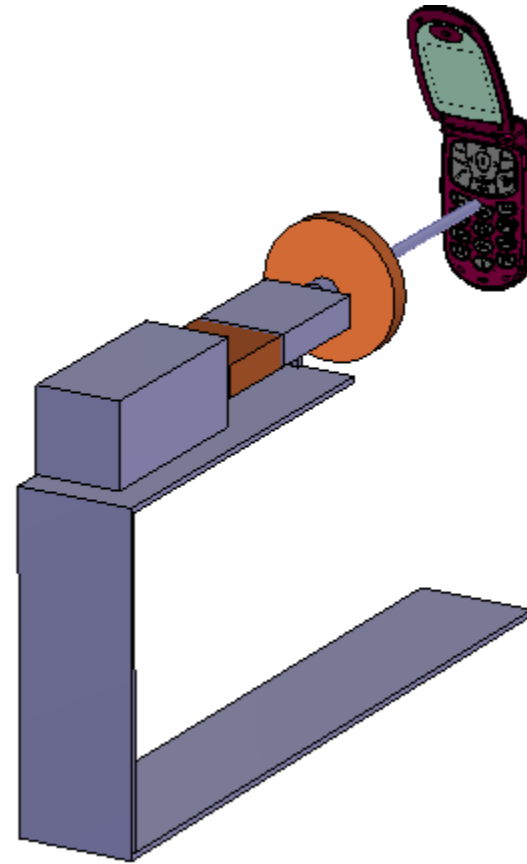
Keywords: PCB, Connector, Cable, USB, Common mode choke, skew, emissions



# Workshop 5: Electrostatic Discharge

Task: Simulate Contact Discharge from an ESD Generator

Keywords: EMC/EMI, ESD, Diode



The aim of this section is to learn how to perform an ESD simulation (contact discharge).



# Workshop 6: CST Cable Studio

CST Cable Studio is introduced through a series of four exercises:

Workshop 6a: Crosstalk Simulation

Workshop 6b: Common Impedance Coupling Simulation

Workshop 6c: Crosstalk Simulation in Shielded Cables

Workshop 6d: EM Susceptibility – Field Coupling into Cables

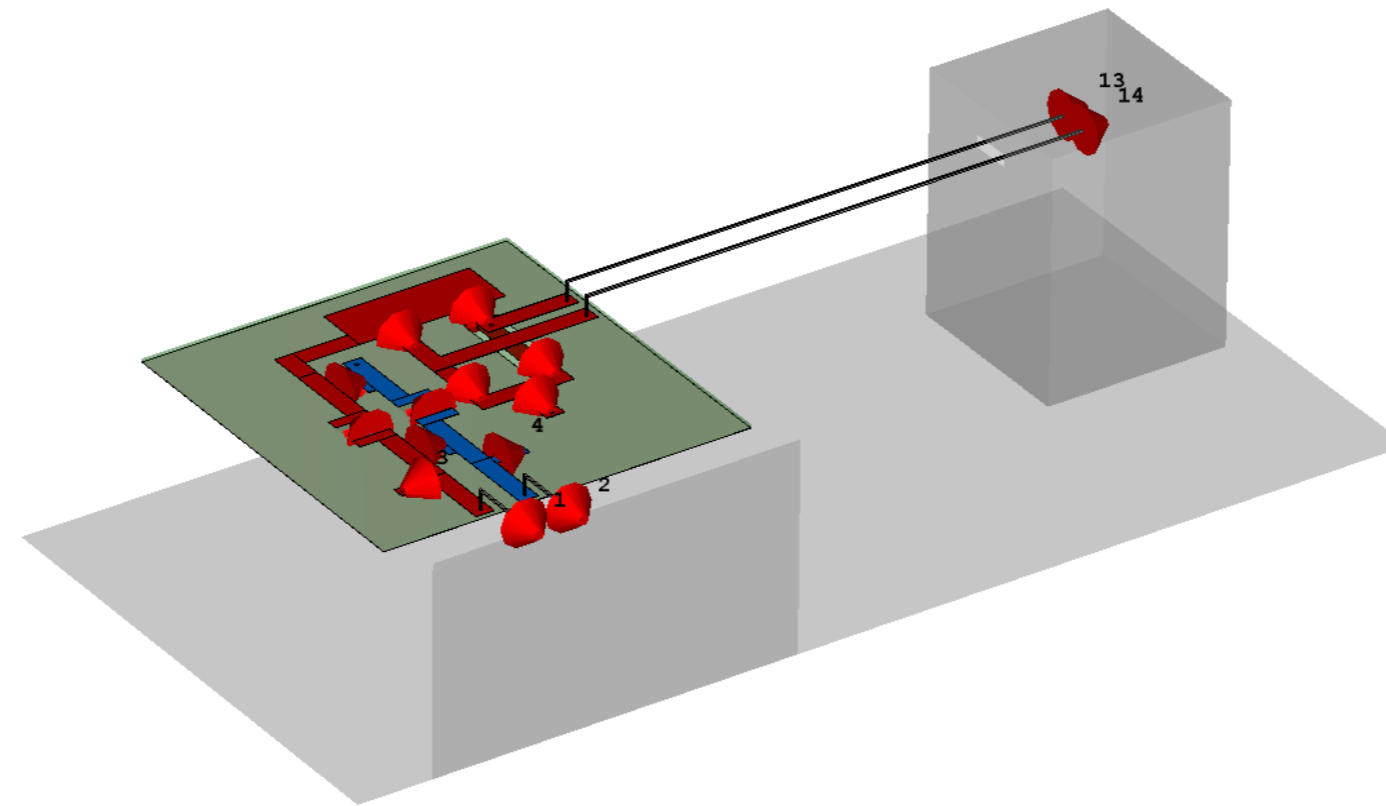
Workshop prerequisite: 3D basic modeling and circuit modeling in CST Studio Suite.



# Workshop 7: Simulating Conducted Emissions from a Motor Control

**Task:** Model an H-bridge as a standalone circuit, then with 3D PCB layout included, and observe the effect on the conducted emissions

**Keywords:** Motor Control, H-Bridge, Conducted emissions, LISN, Combine Results, EMI Filter



# Workshop 8: Simulating Conducted Emissions from a DC/DC Converter

Task: Model a DC/DC Converter and simulate conducted emissions, investigating the improvement from an EMI Filter

Keywords: SMPS, Buck Converter, Conducted emissions, LISN, Combine Results, EMI Filter

