EM-Twin Exposure Tutorial Ka-band horn antenna: APD evaluation





Overview

- New project creation
- Using the Exposure Wizard
- Antenna digital twin creation
- Phantom definition
- Field source placement
- Simulation set-up
- Parameter Sweep
- Near field and APD evaluation





Start

- Start EM-Twin
- Select "New Project"
- Change Drawing Unit to mm
- Press OK
- Press Save as & create a storage folder and enter file name, e.g., "Exposure_APD"
- Press Save

New Project	Open Project	Examples	Templates Tutorials	
General			Getting Started	Application Notes
Structure Type	Standard		Ir.1	-Twin Exposure Tutorial (FM) Import 3D CAD data into Empire XPU
Solvers	EM		TWIN	Started Manual (IV) Empert lawout dots from Empire VIII
Drawing Unit	1		Jr.,1	
Frequency			TWIN Open the Full Man	ual [#4] Import layout data into Empire XPU
End Frequency	20	✓ GHz ✓	Visit our Empire Youtube Channel	Calculate far field radiation patterns
Target Trequen	10	UII2 ·		(EM) Far Field visualization
Loss Calculation	lacelass			trad
Conductors	lossless			Meshing and Discretisation
				(紙) Parametric objects and values
				(EM) Variation and optimization of parameterized mode
				(FM) Distribute different simulation jobs to convers
1-Twin 9.1.0 - draft_00)2.emt (New Proje	ct)		
e <u>E</u> dit <u>V</u> iew	<u>S</u> election	<u>U</u> tilities <u>I</u>	<u>H</u> elp	DFT: Signal Resonance Estimation
2D Desig	in 📕	3D	Desig	(III) Project migration from CST to Empire XPU
		New Mation		(FM) Project migration from HFSS to Empire XPU
	· ·			(FM) Eilter Synthesis Template and full wave analysis
> 📔 📘	1 🔒			
	ave As		-	[44] Thermal simulation
				(H) Conformal Dielectric
	ave the curre	nt state to	a new	(Im) Multi PC Solver
- · · · ·	oroject	_		Tr.A
				[##] Read-Protected Part





Wizard step 1: CAD Import



 Under 3D Design > General, click on the icon "EM Twin Wizard (exposure)"





Wizard step 2: Create source

- Select option Convert R+S Format
- Locate folder with the R&S measurement data and left-click on folder name (R_S_data_HSA_30GHz)

The frequency must be selected if an antenna has been measured at several frequency points and if the corresponding nearfield currents have been created

Click Close once the import is finished

This way, the source file for the antenna digital twin

"R_S_data_HSA_30GHz_30000MHz.surf.dat" is created in the project folder.

The 3D radiation pattern of the source will be shown in the Wizard if it is available (not in this example)

Place and Setup Antenna Field Source Convert R+S Format (folder containing NFFF_InputData and NFFF_OutputData Convert EMPIRE 2D-near-field Format ("Farfield_*" file) Select Surf-Dat File:	~	
Convert R+S Format (folder containing NFFF_InputData and NFFF_OutputData Convert EMPIRE 2D-near-field Format ("Farfield_*" file) Select Surf-Dat File:)	
Convert EMPIRE 2D-near-field Format ("Farfield_*" file) Select Surf-Dat File:		1
Select Surf-Dat Fle:		1
PIE		
PIE PIE PIE PIE PIE PIE PIE PIE VIE VIE VIE VIE VIE VIE VIE VIE VIE V		
V		
v		
V		
x ² x		
Placement/Origin		
Importing Current Based 2D Nearfield Data ? X		
IP 1 0 0 IP 1 0 2		
IP 1 0 3 IP 1 0 5		
IP 1 1 0 IP 1 1 2		
IP 113		
		ancel
IP 2 0 1 IP 2 0 3		
IP 2 0 4 IP 2 1 0		
IP 2 1 1 IP 2 1 3		
IP 2 1 4		
Finished		
	and a	
📑 Save Log 📜 Clear Log		
Close Help		

Wizard step 3: Field source configuration

- Click 'Enable Reflector'
- Set Reflector Surface Distance to 0.05

The field source is usually transparent to electromagnetic fields while the real antenna contains usually several metal parts. Defining a reflector inside the field source builds a more realistic digital antenna twin source setup. Electromagnetic waves are often reflected from the phantom so that a volume with standing waves exists between the phantom and the antenna^{*}.

Optionally the Reflector Surface Distance can be set to "automatic" to create a varianble with which the distance can be swept with a distance about lambda/2 in small steps to ensure that the worst case exposure is evaluated.

Press Next



* IEEE Journal publication: Absorbed Power Density Assessment Using Simulation-Augmented Over-The-Air Measurement https://ieeexplore.ieee.org/document/10440586



Sep-24 © IMST GmbH - All rights reserved



Wizard step 4: Flat phantom setup

This step defines the flat phantom for the exposure investigation. Permittivity and Conductivity must be defined for the antenna frequency. (30 GHz in our case)

- Define permittivity as 15.51
- Define Conductivity as 27.1
- Define a variable to investigate a few phantom distances in one simulation setup (open pull down menu and select ph_dist)
- Set Averaging Area to 4 cm²
- Click Next

Material Setup Rel. Permittivity 15.51 Conductivity [1/(Gm)] 27.1 Defisity (g/cm³) 1.0 Poston Setup Poston Setup Pite Pite Pite	PIE PIE PIE PIE PIE PIE	
Rel. Permittivity 15.51 Conductivity [1/(2m)] 27.1 Density (g/cm?) 1.0 Position Setup 2-max Half-Space Phantom Space 2-max Half-Space Distance to Source Surface (in drawing units) ph_det Phantom Width Oversize (in drawing units) ph_det Phantom Degtb.(ar drawing units) 0.5*lambda0_target Phantom Degtb.(ar drawing units) 0.5*lambda0_target Normalization-Power (W) 0.001	PIE PIE PIE PIE PIE PIE	
Conductivity [1/(Ωm)] 27.1 Density (g/cm ³) 1.0 Position Setup Phantom Space Pite Pite Pite	PIE PIE PIE PIE PIE PIE	
PIE P	PIE PIE PIE PIE PIE PIE PIE PIE	
PIE PIE	PIE PIE PIE PIE PIE PIE PIE PIE	
PIE PIE	PIE PIE PIE PIE PIE PIE PIE PIE	
PIE PIE	PIE PIE PIE PIE PIE	
PIE	PIE	
PIE		
PIE PIE PIE Averaging Area (cm ²) Averaging Definition IEEE 63195-2 Def. 1 (sPD n+) Normalization-Potwer (W) 0.001	PIE PIE	
Averaging Area (cm ²) Averaging Definition Normalization-Power (W) 0.001	PIE	
V Averaging Definition IEEE 63195-2 Def. 1 (sPD n+) Normalization-Power (W) 0.001		
Normalization-Power (W) 0.001		
	v	
	OLE	

< <u>B</u>ack <u>N</u>ext > Car



Wizard step 5: Simulation set-up

Simulation and mesh settings can be adjusted in this step. The default settings do not need to be changed for this tutorial

Click Finish

The variable which defines the distance between the antenna and the phantom is defined in the next step. We want to look at several distances.

- Switch Type from *Constant* to *Stepped* Enter the following values: Start: 2 Stop: 30 Step Value: 2
- Press OK



Step 6: Model check



- Switch to 3D Design mode
- Select Iso-z view and check model







Step 7: Parameter Sweep

- Switch to Simulation Tab
- Select "Parameter Sweep Setup" on the left
- Click on Create Parameter Sweep
- Confirm sweep





S

Step 8: Setup parameter sweep

- Change Sweep mode from 'Sweep independent' to 'Sweep Parameter Space'
- Click "Start" and wait to finish (15 simulations)

2D Design	3D Design	Simu	lation	2D Results	3D	Results								
s • 🖻 🗭 🖪	Simulation	Getup 📑 Host S	etup 🜔 Start	💽 Start Comp	ete Simulation	Single Actions	Start Simulation	Post-Processing	Manage Actions	🛒 Auto Close Idle	🚺 Kil All	💽 Stop All	Delete V-Opts	
ulation Tasks ameter Sweep Setup		etup Status			/									
binization Setup phaned V-Opts		Sweep Mode: Sweep Count: Creation Mode: Folder Naming Policy V Re-Simulate Out	Sweep Paramete 15 Export and Run : Active Variables dated	r Space 🔹										
		/ariable Setup												
		Name * FDTD Variables	Туре	Value	Start	Stop	Step / Count	List / Equation						
		└─ ✔ ph_dist	Stepped		2.0	30.0	2.0							
													v-opt-00006	/ sub-1 (Running) (0%)
													13	
And and a second se													and the second s	



Step 9: 2D Results

- Switch to 2D Results –
- Press Add Sweep
 Results







Step 10: 2D Results

Change Plot Type to Surface Power Density (Meta Data)







Step 11: 2D Results

• Enable legend

Part Conv	Edit Utilities Help 2D Design 3D Design Simulation 2D Results	EM-Twin 9.1.0 (build 2 30 Results
and by seven shale we have the shale of the shale being (Ma Charles and Shale	: General Scale/View Mode ✔ 19 19 19 19 + +t _{ix} ¥ 19 18 18 19 10 02 02 02 02 02 00	
for the second	bibe Sweep & Curve Setup 'ype: Surface Power Density (Meta Data) ormat: Value ph_diat v value ph_diat v value Argument v value Argument pe emvolume_1	Column 1 Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Scattering Plannetes Column 2 Column 2
uwnig 1 û 1 cuives	ing 1 of 1 curves	



Step 12: 3D Results APD distribution

- 1. Switch to 3D Results & Turn off group phantom (left click on light bulp)
- 2. Open Variables and adjust variable values to show dedicated APD distribution

