SynMatrix

Introducing a new era in RF/Microwave Simulation and Component Development

ANSYS Preferred Solution Partner

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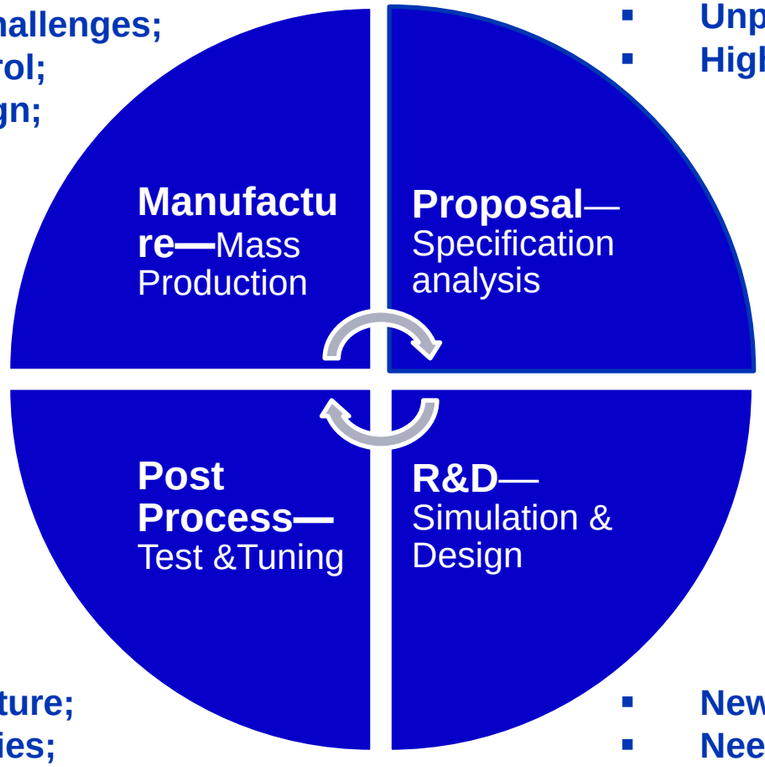
Industry Tendency & Design Challenges

Design Challenges to passive component;

- Manufacture Challenges;
- Tolerance control;
- Yields vs. Design;

- Unpredictable behavior
- Highly rely on experience



- The Challenges are throughout the whole product life cycles;
- To lower the risk, engineer needs to control the quality from the beginning stage---design & simulation
- Simulation performance is critical to the final performance;

- Non-tune Structure;
- Test Uncertainties;
- High labor cost & Training

- New structure & New material
- Need high precise simulation
- Time vs. Cost

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SynMatrix Intelligent Design Platform

SynMatrix is an intelligent cloud-based design platform for RF engineers and technicians to help accelerate the RF component design and manufacturing process

Proposal & Analysis

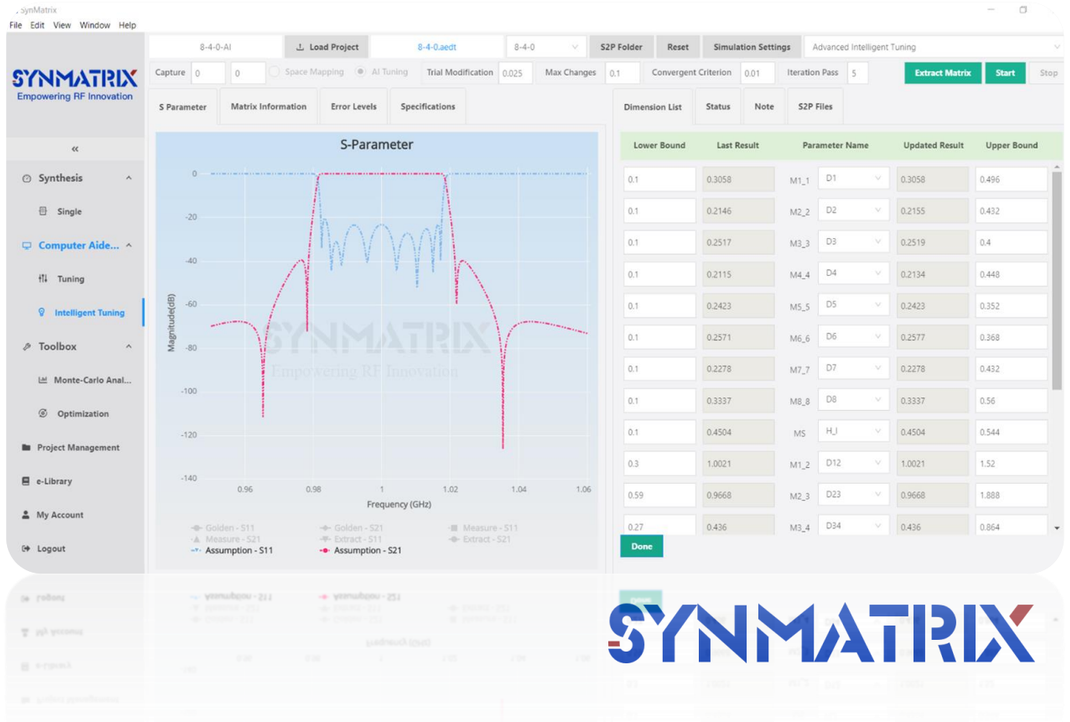
- Coupling matrix synthesis
- Dispersive effect prediction
- Matrix optimization & sign change
- Peak power handling
- Monte-Carlo analysis
- Design margins analysis
- Shift f0&BW + Nonuniform Q
- S2P & Matrix file import/export

Sim & Design

- Computer-aided tuning & diagnosis
- Advanced coupling matrix extraction
  - Two ports tuning
  - Multi-ports tuning
  - Generic optimization
- AI optimization system
- Manually Tuning system--Aggressive space mapping

Tuning & Manufacture

- To be releasing soon



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Filter Application Overview

Passive components are used across many industries including telecommunications, military, space exploration, and medical.

Portion of the Radio Spectrum

Very High Frequency	L and S Band	mm-Wave Application
30-300MHz	0.3 – 3Ghz	3 to 90Ghz

Ground, Aircraft Comm

Marine and mobile radio

Mobile Phones

GPS

Comm Satellites, Satellite TV Broadcasting

5G networks, Smart Cities

Military Ops

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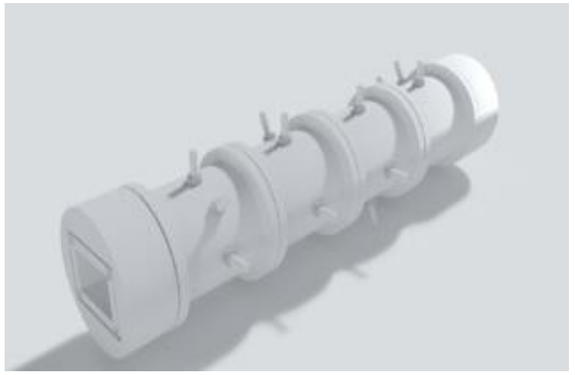
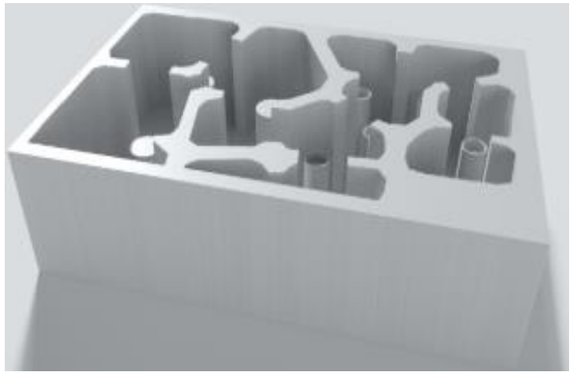
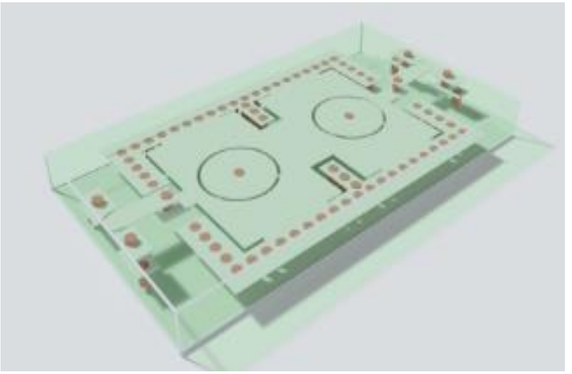
Filter Structures, Applications



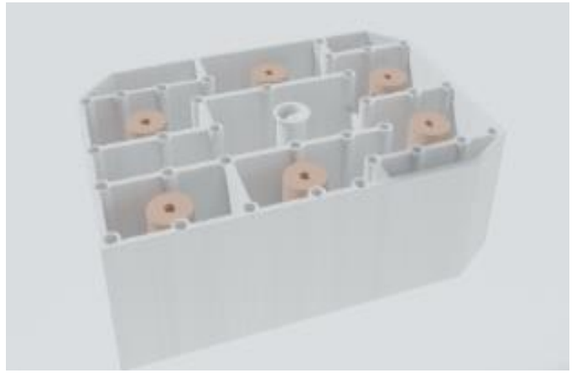
Waveguide



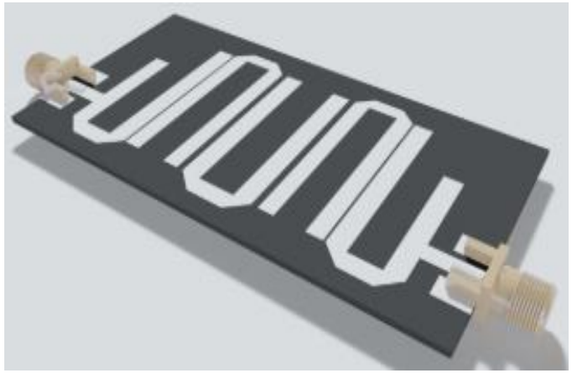
Cavity/Reentrant



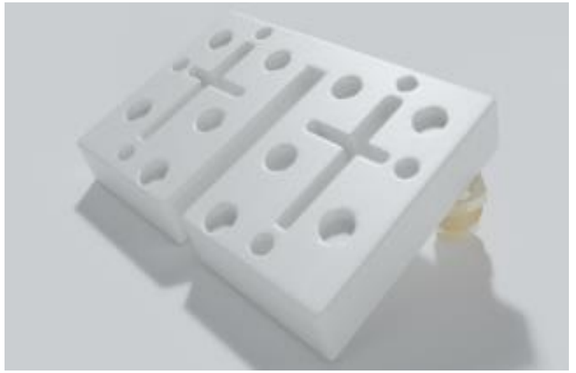
LTCC



Ceramic Filter



Microstrip Line



Ceramic Waveguide

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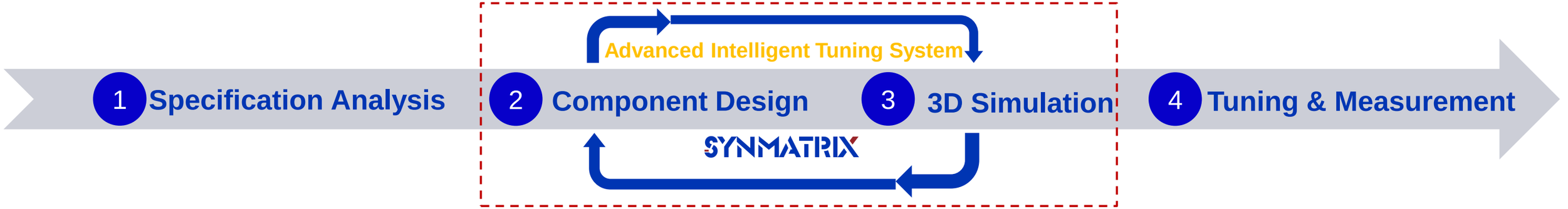
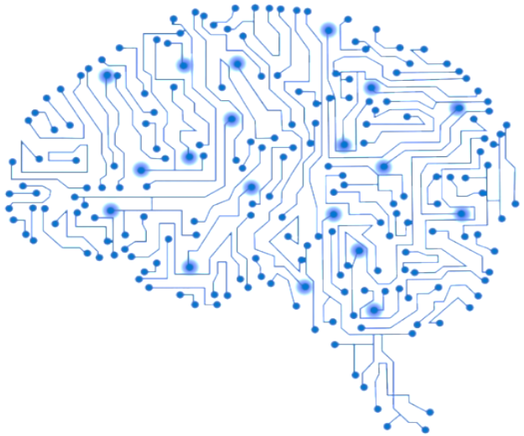
AI Design Platform Introduction

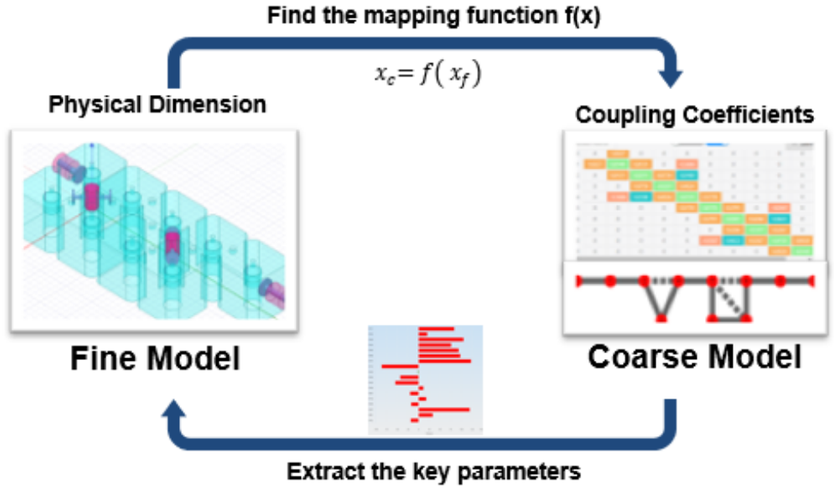


Feature 1: AI Tuning & Space Mapping Technique

-- Provide flexible optimizer to adopt different applications & structures;

- ✓ **AI** Cored advanced algorithm
  ---Reinforcement learning method
- ✓ **M**odified **O**riginal **S**pace **M**apping(**MOSM**)
  ---Stable and Accurate;
- ✓ **A**ggressive **S**pace **M**apping(**ASM**)
  ---Efficient and Fast;





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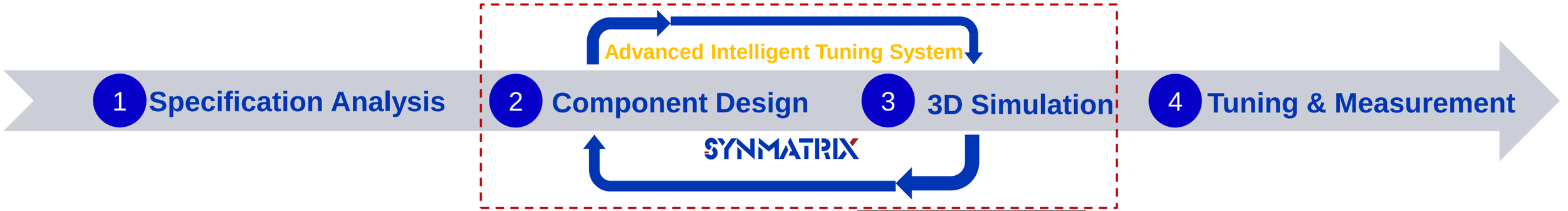
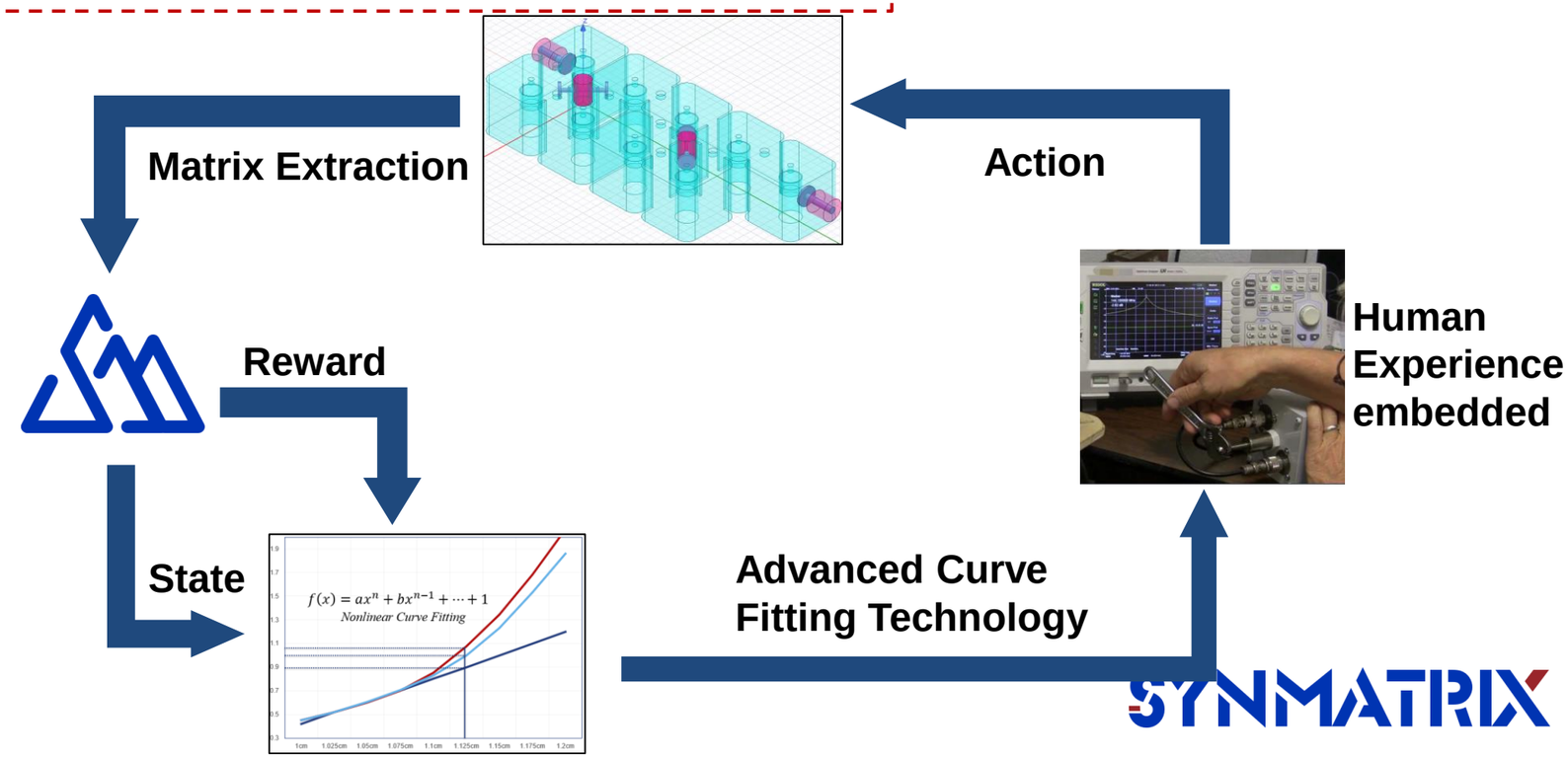
AI Design Platform Introduction



Feature 2: AI tuning system---

Reinforcement learning system embedded with human experiences

- ✓ High efficiency without long time training process;
- ✓ Advanced curve fitting technology
  ---Fast and Accurate;
- ✓ Stabilized control system
  ---Anti-crash monitor;



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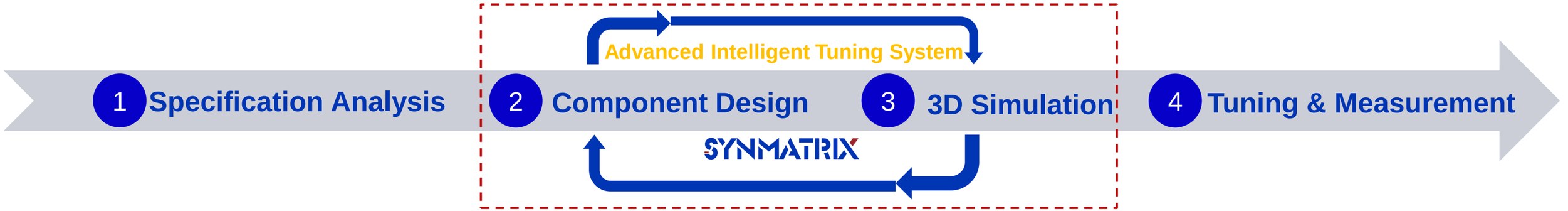
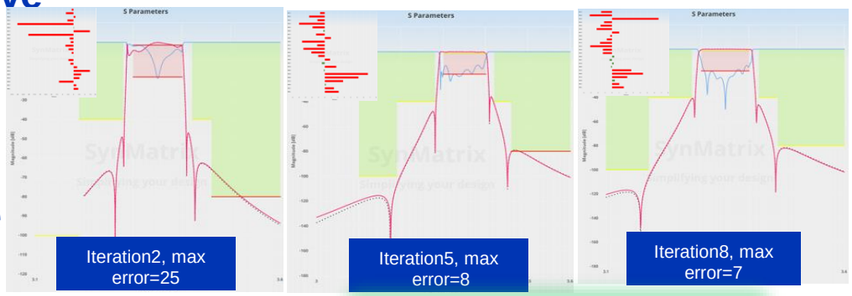
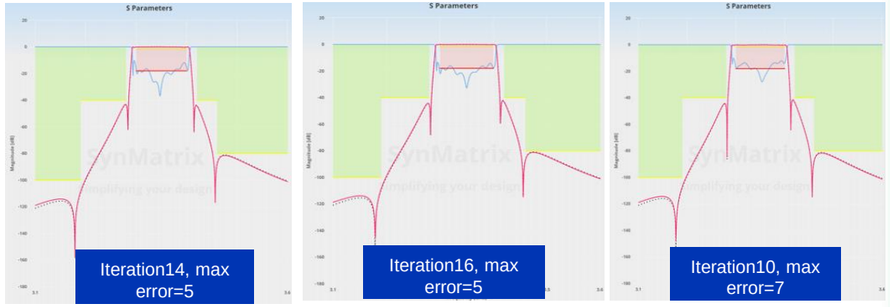
AI Design Platform Introduction

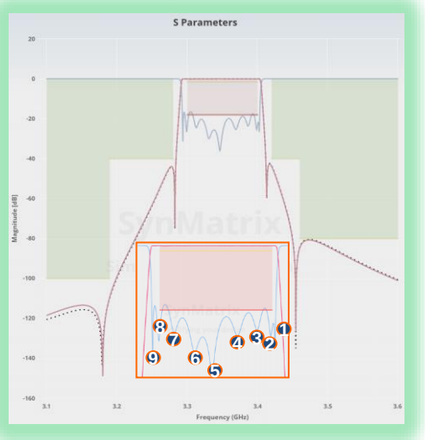


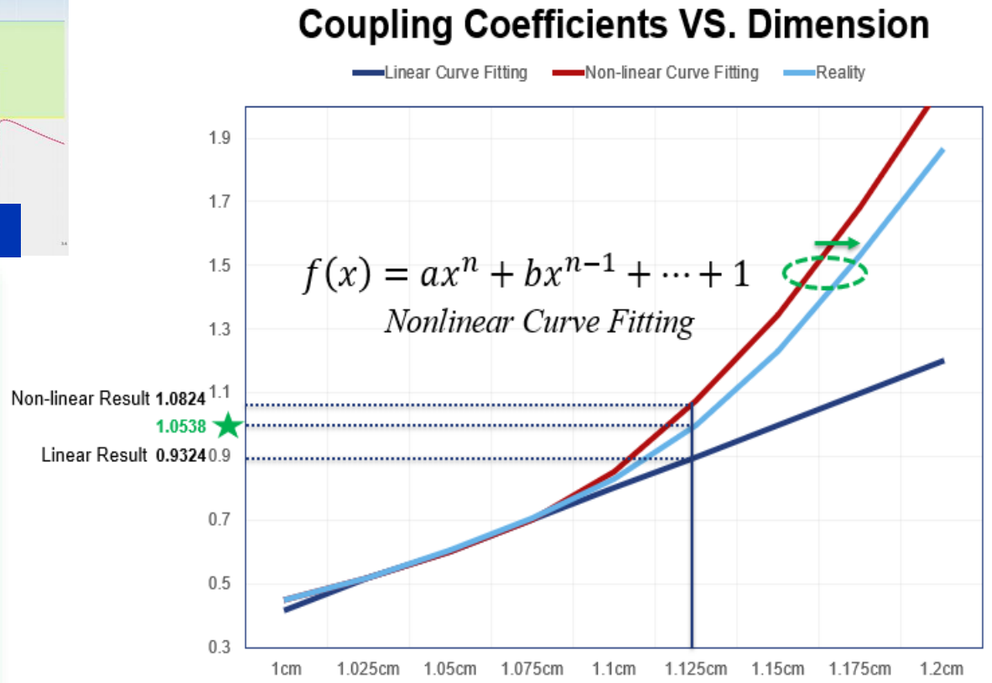
Feature 3: Advanced non-linear curve fitting algorithm;

- ✓ Multi-functional polynomial fitting technology;
- ✓ Multi-path finding algorithm to find the global minimum;









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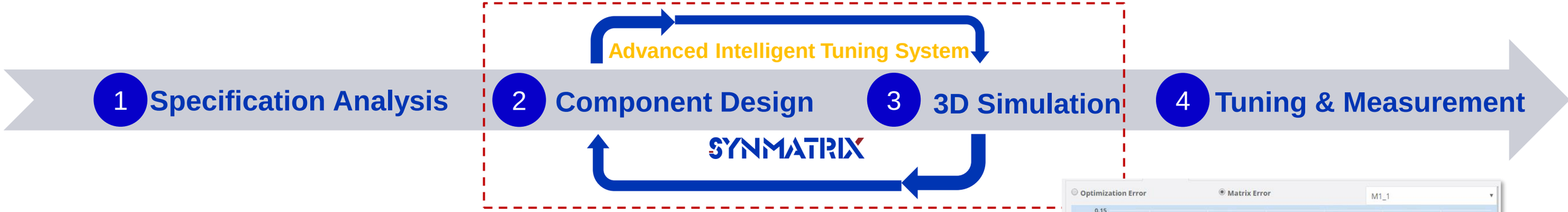
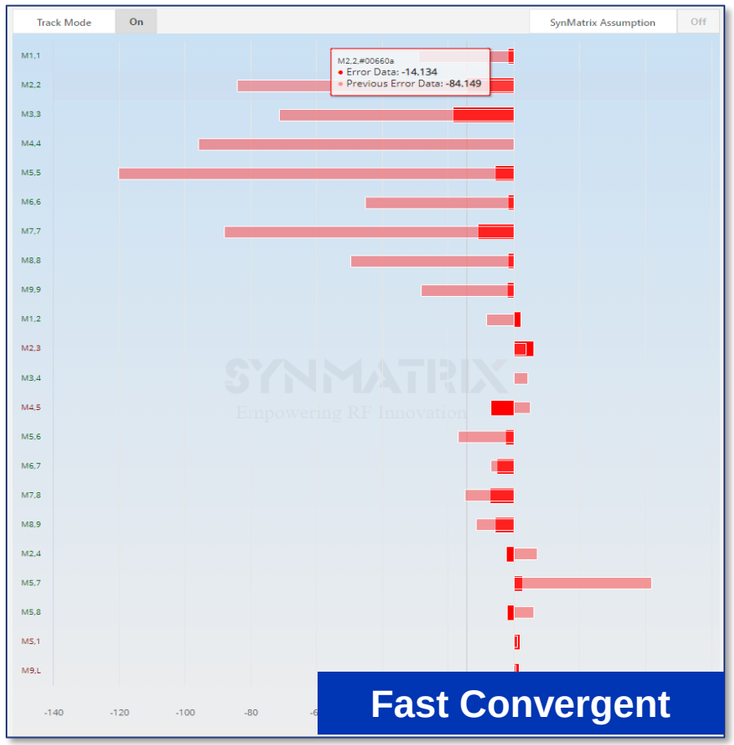
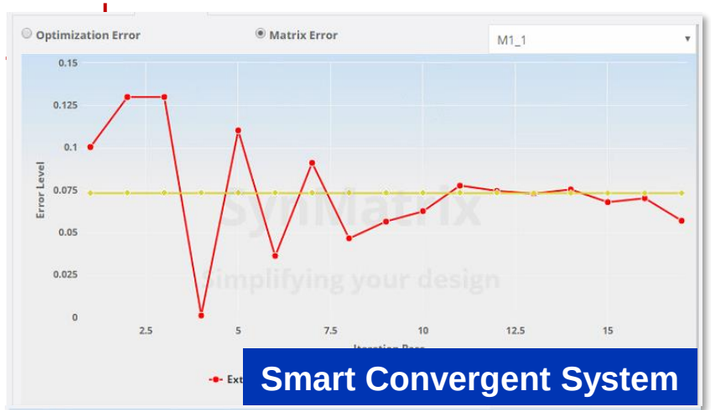
AI Design Platform Introduction



Feature 4: Anti-error mechanism & Smart convergent system;

- ✓ Fast convergent and stable;
- ✓ Multi-path finding algorithm to find the global minimum;
- ✓ Smart convergent system—To avoid the performance oscillating and ensure the fast converge;





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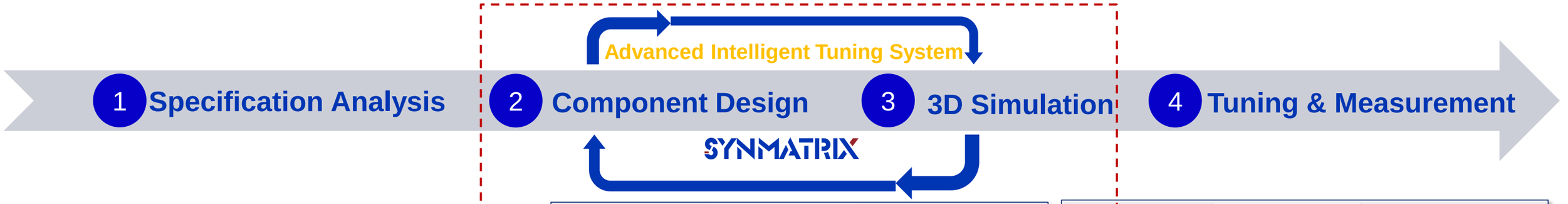
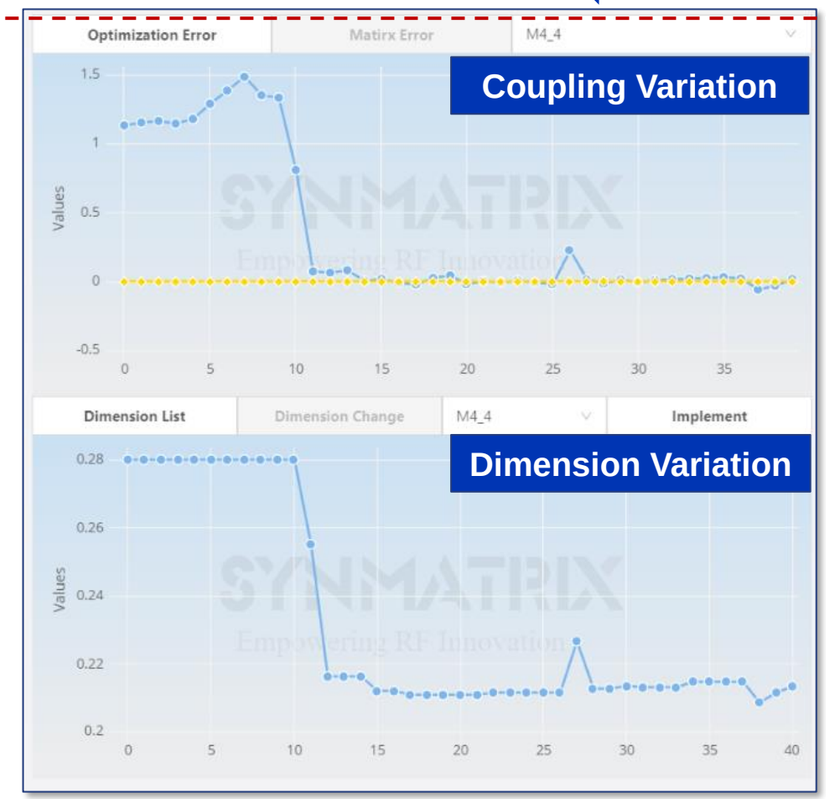
AI Design Platform Introduction



Feature 5: HFSS remote control & Running process overview;

- ✓ Express HFSS config management & Remote control;
- ✓ Running process overview--- Dimension change VS. coupling coefficient changes;
- ✓ Best result recommendation;



ParaName	26	27	28	29	30	31
Optimize Error	0.0447	0.2426	0.0653	0.0446	0.0364	0.0488
M1_1	0.3057	0.3057	0.3057	0.3057	0.3057	0.3057
M2_2	0.2149	0.2149	0.2149	0.2149	0.2149	0.2149
M3_3	0.2513	0.2516	0.2516	0.2516	0.251	0.2519
M4_4	0.2115	0.2266	0.2127	0.2127	0.2135	0.2131
M5_5	0.2419	0.2418	0.2418	0.2418	0.2418	0.2418
M6_6	0.2579	0.2593	0.2593	0.2593	0.2588	0.2584

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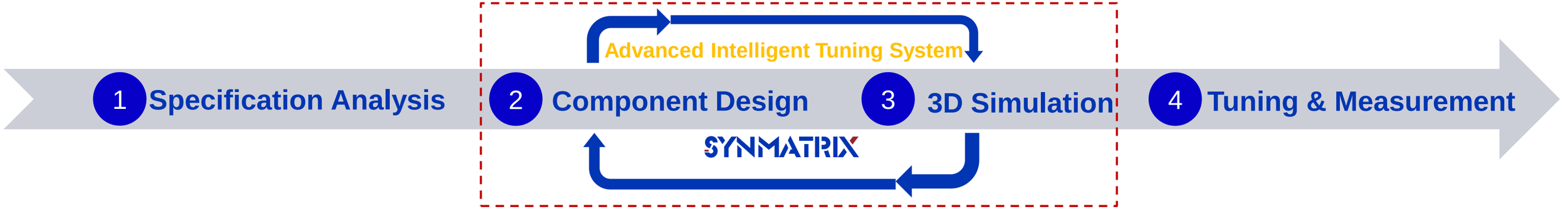
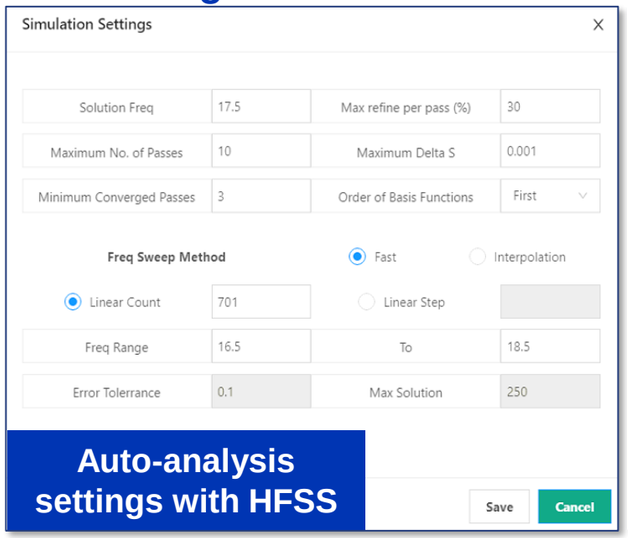
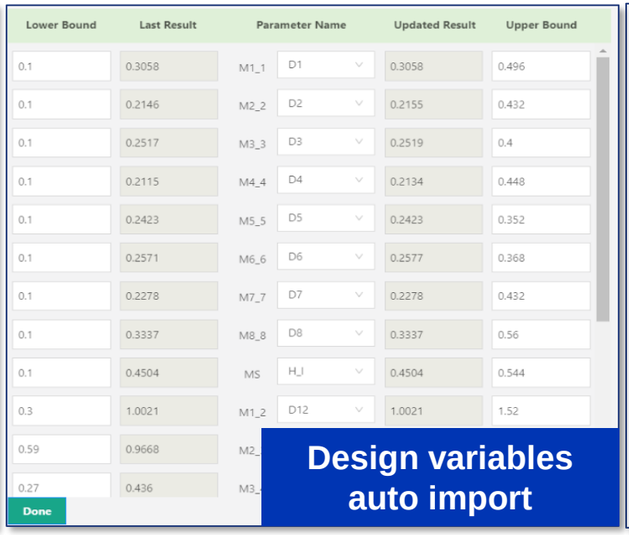
AI Design Platform Introduction

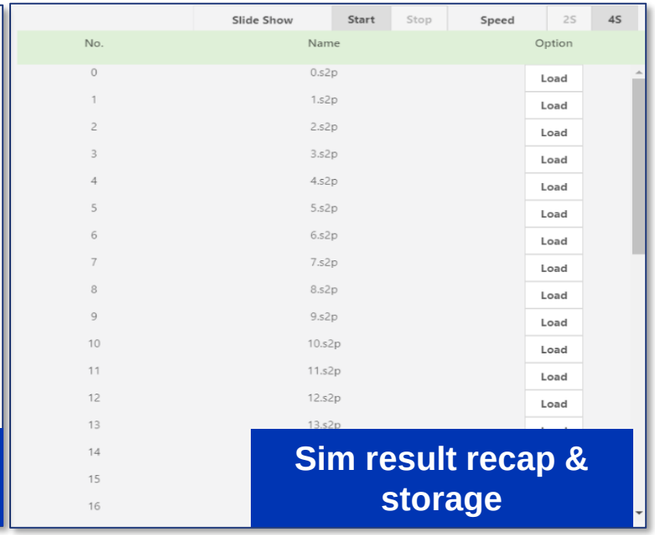


Feature 5: HFSS remote control & Running process overview;

- ✓ Directly import and HFSS design & variable parameters
- ✓ S2P file directly storage;
- ✓ Simulation result recap;







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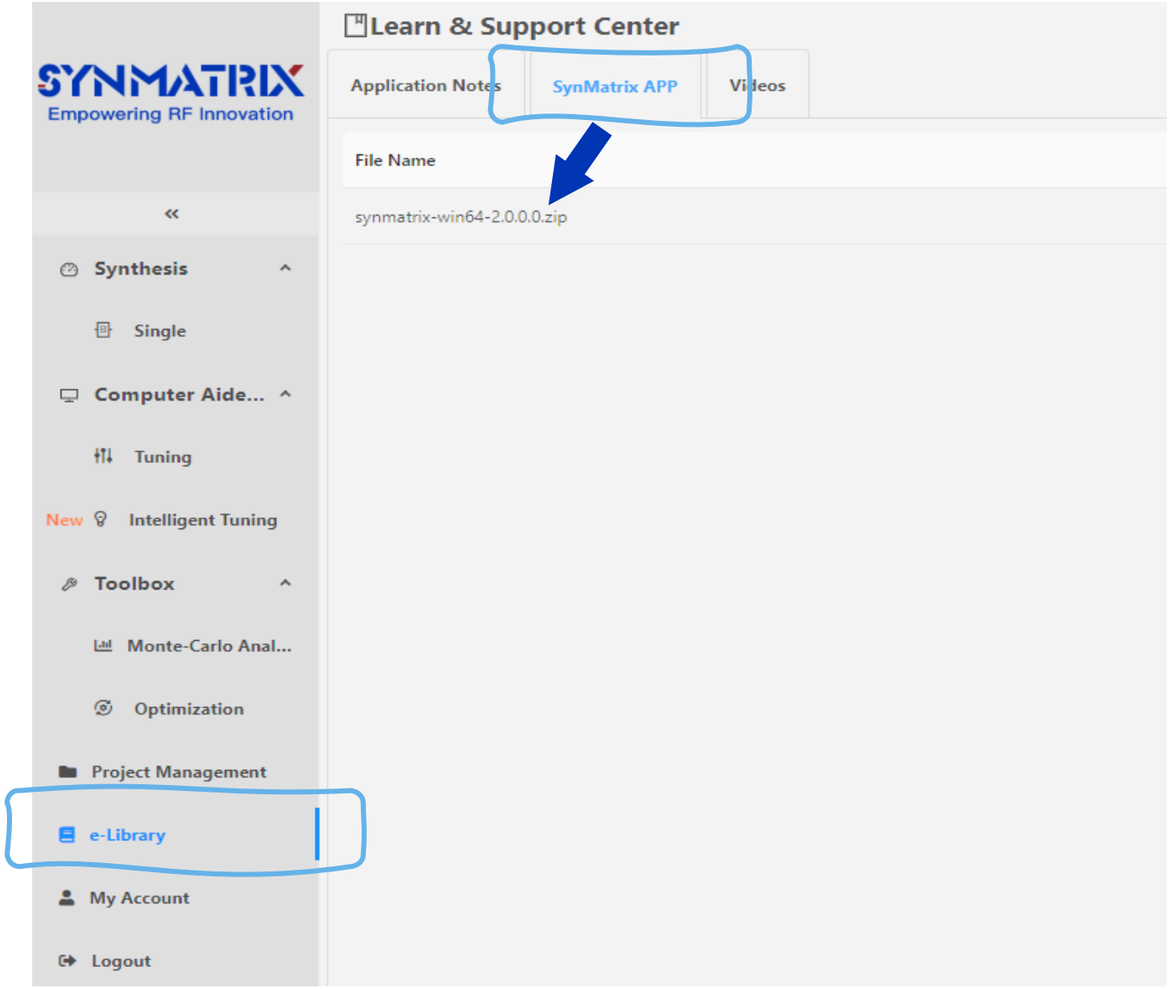
Prior to Proceed AI Automatic Running

1. Download “Synmatrix APP”



Before proceeding the automatic running simulation, user needs to download the “Synmatrix APP” from our website under “e-Library”

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Prior to Proceed AI Automatic Running

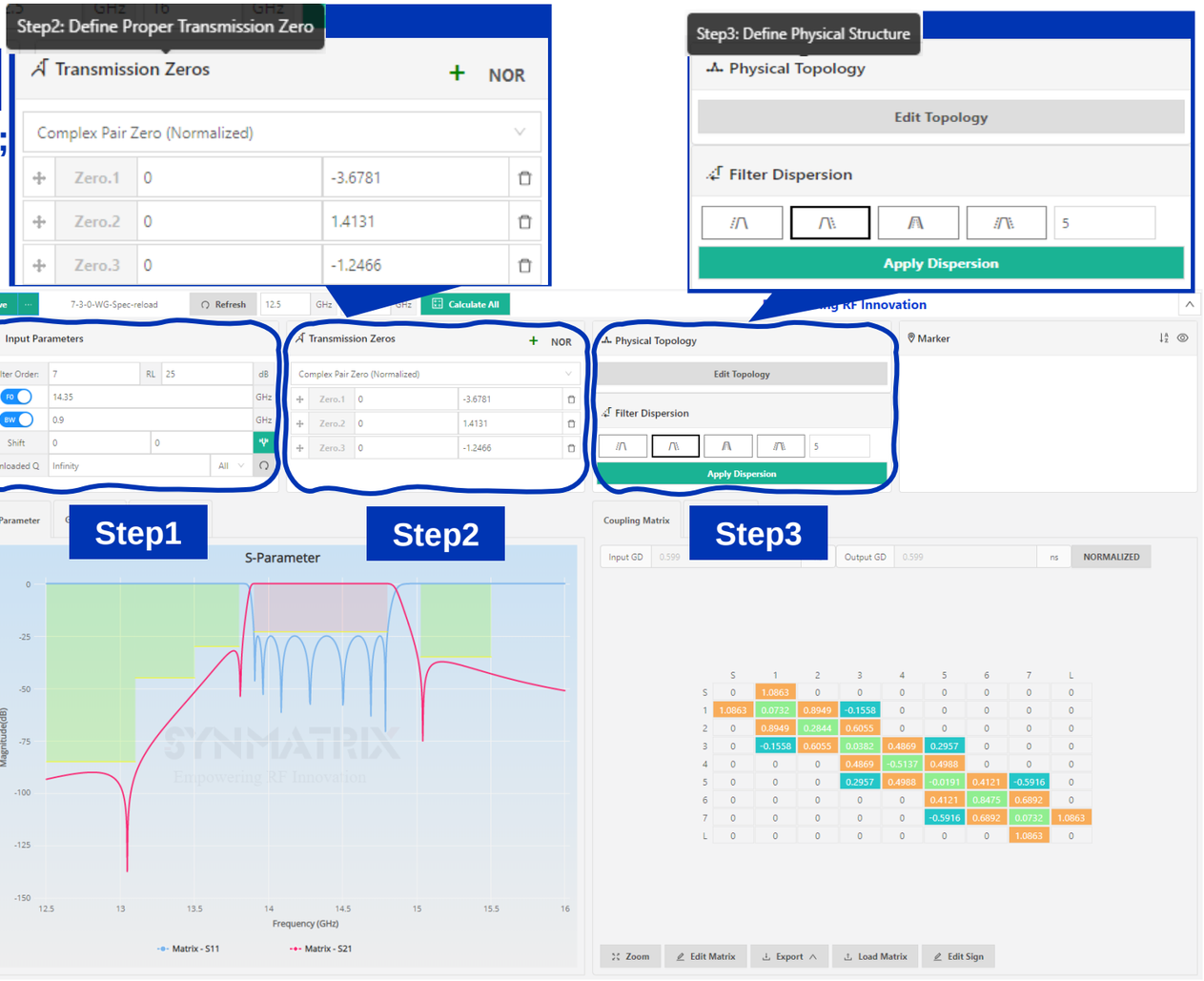
2. Synthesize the coupling matrix

Step2: Input trans zeros

- Normalized & Real Freq;
- Complex pair zero;

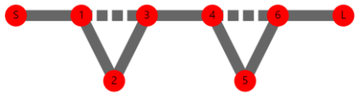
Step1: Input filter information

- F0, BW, RL, Filter order,
- Unloaded Q--- Uniform/Non-uniform;
- Fine tune: Shift f & BW;



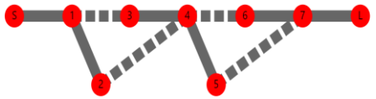
Step3: Setup proper topology

- Arbitrary topology;
- CT, CQ, Box section, etc;
- Dispersion effect control;

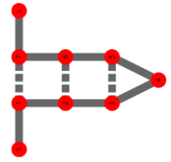


Ex: CT;

Ex: CT & CQ cascade;



Ex: Extend Box;



Ex: Folded Structure;

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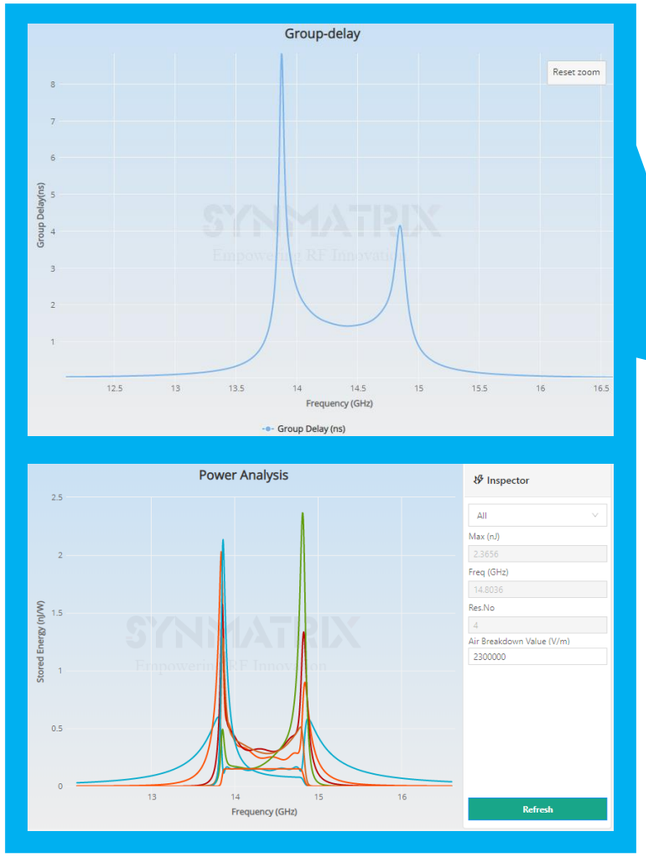
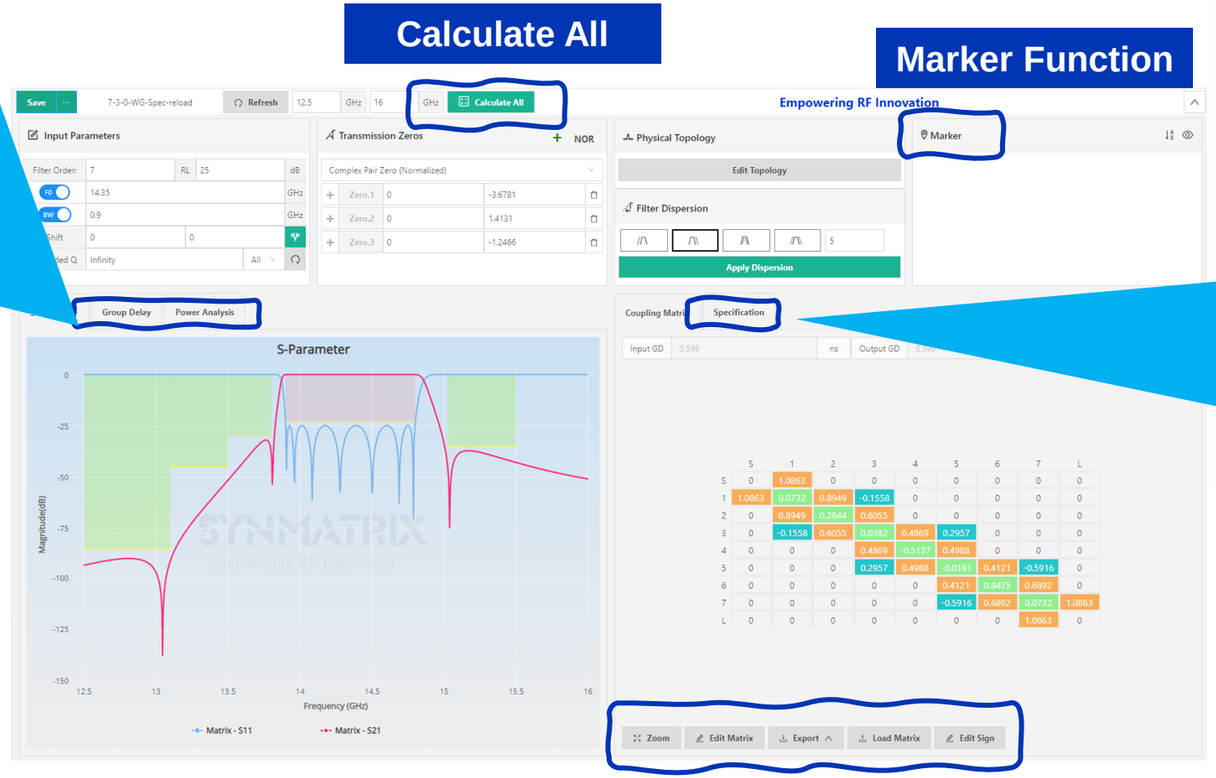
Prior to Proceed AI Automatic Running

2. Synthesize the coupling matrix

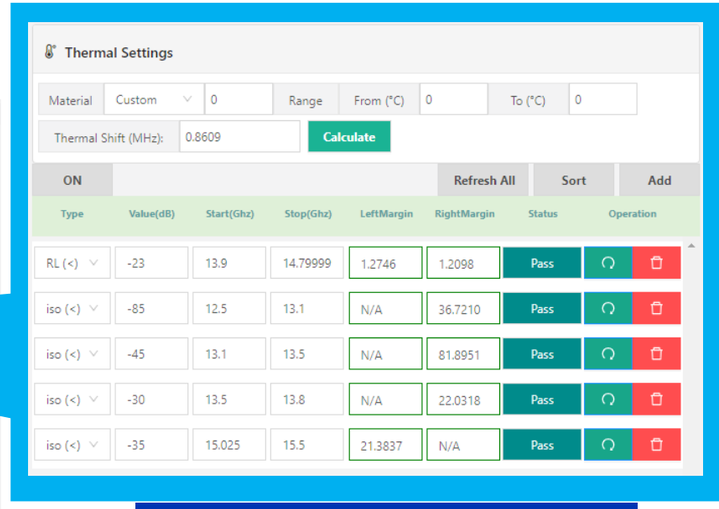


Graphic Result: S Parameter, Group Delay, Store Energy

Calculate All



Marker Function



Thermal Drift Prediction & Specification Analysis

Export S2P & matrix file; Edit Matrix; Upload Customize Matrix; Matrix Sign Change

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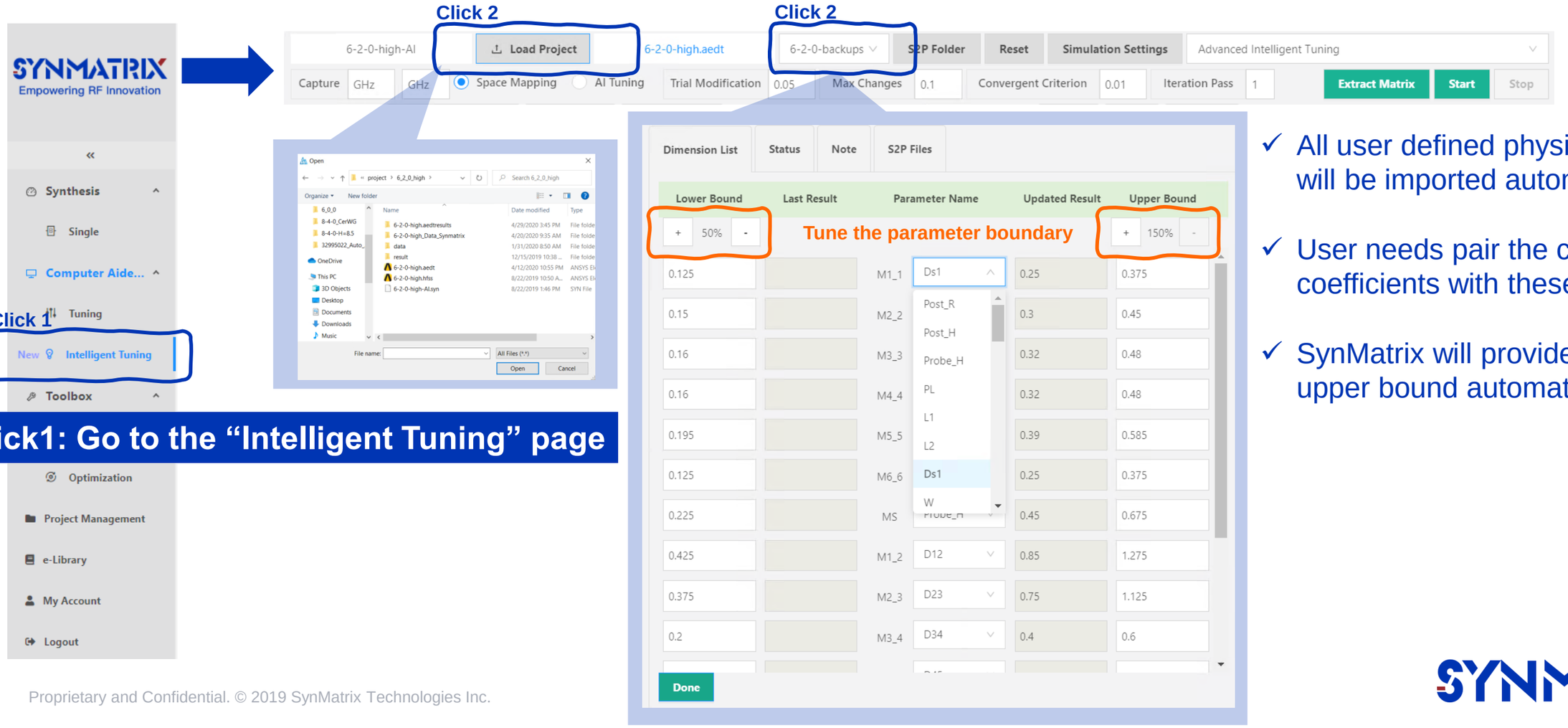
AI System Working Flow: 7 Clicks Within 3 Steps

Step 1: Load the HFSS file and set up the dimension parameters;

Click2: Load the HFSS project and select proper design



Click1: Go to the "Intelligent Tuning" page

- ✓ All user defined physical parameters will be imported automatically;
- ✓ User needs pair the coupling coefficients with these dimensions;
- ✓ SynMatrix will provide lower and upper bound automatically;

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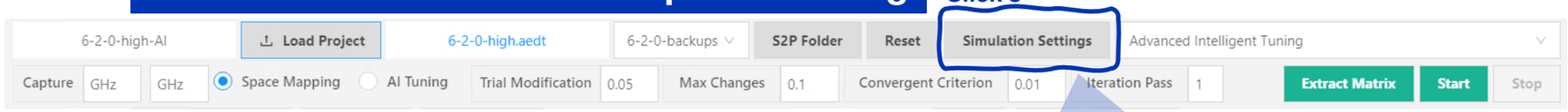
AI System Working Flow: 7 Clicks Within 3 Steps

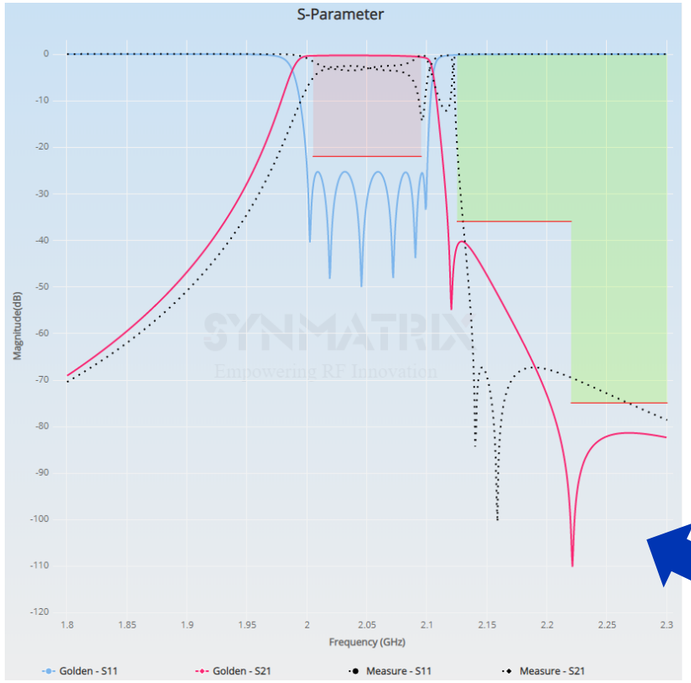
Step 2: Setup the simulation parameters and obtain the initial response;

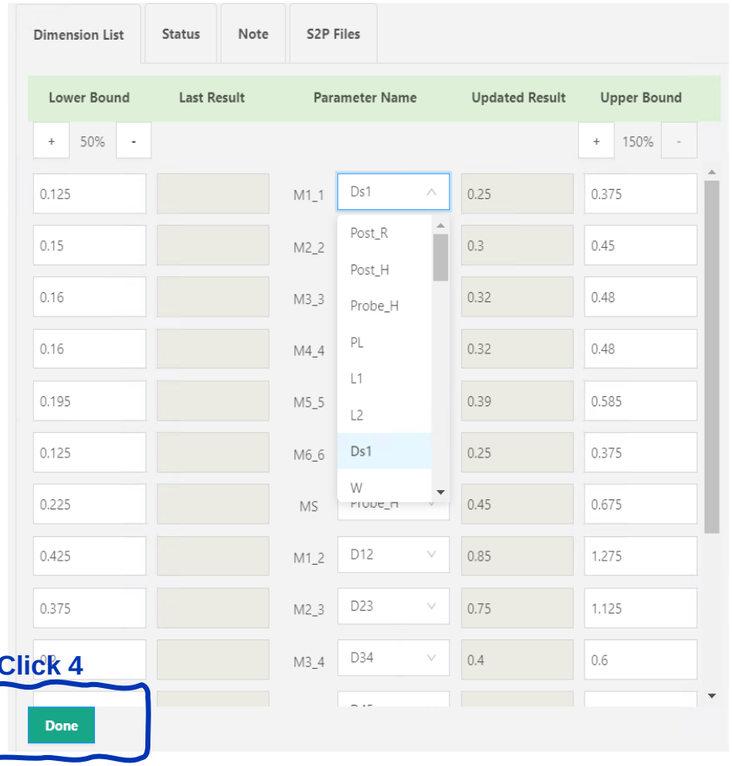
Click 3: HFSS simulation express setting

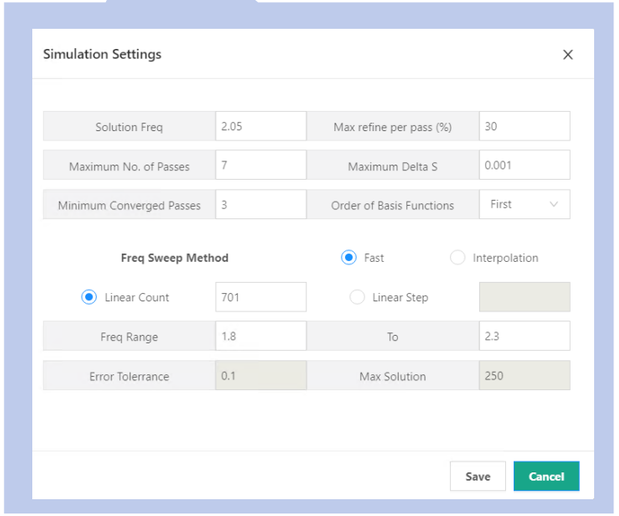
Click 3



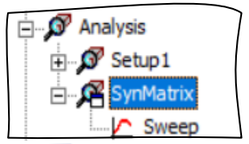
- ✓ Once the simulation has done, the S2P file will be exported from HFSS and import to SynMatrix automatically;







- ✓ SynMatrix will recommend proper analysis values and build the setups in HFSS automatically to stream the design process



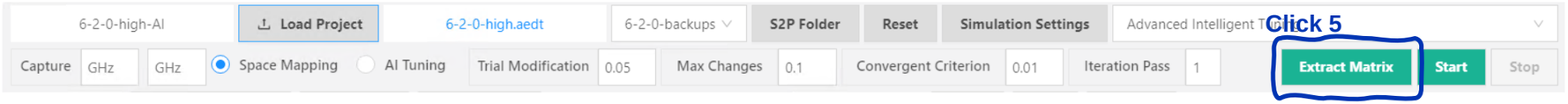
Click 4: Click “Done” to drive HFSS to simulate the initial performance

Propr

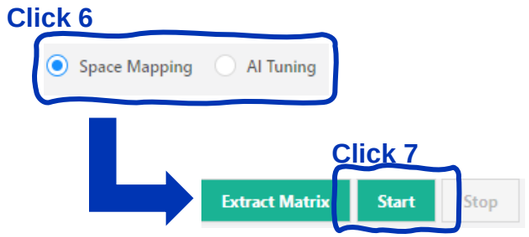
Working Flow: 7 Clicks Within 3 Steps

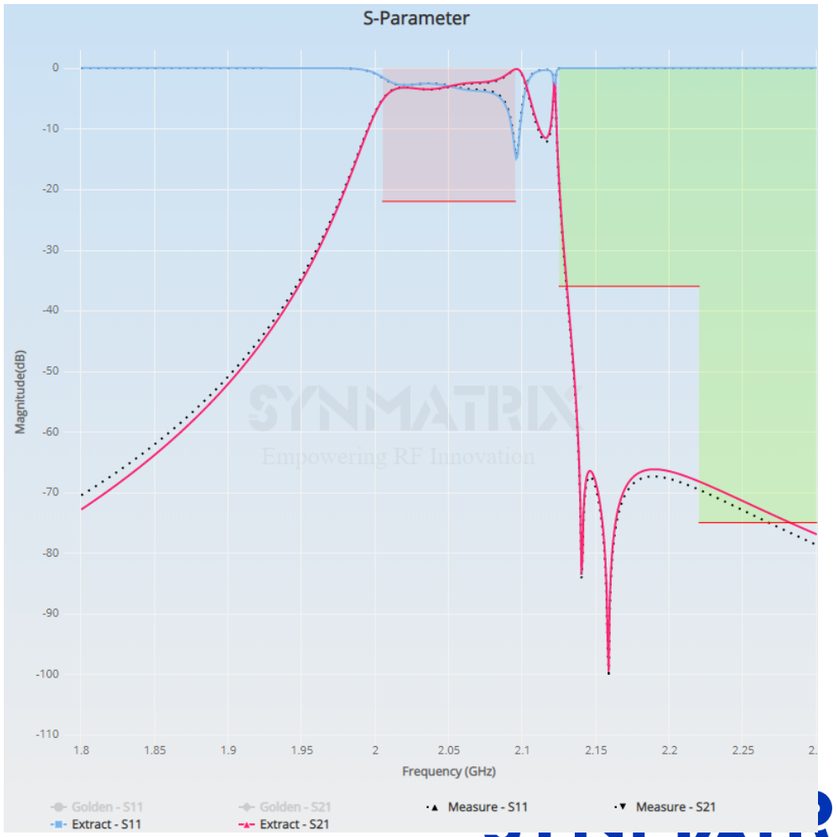
Step 3: Select the optimization method and click “Start”;

Click 5: Click “Extract Matrix” to obtain the initial error evaluation



Click 6 & 7: Select the optimization method and click “Start” to run





- ✓ **Trial Modification**:
  - Physical dimension changing value used in initial training purpose;
  - Inappropriate value will result in the inaccurate nonlinear over-fitting effects and decrease optimization efficiency;
- ✓ **Max Changes**:
  - The maximum physical dimension changes during the auto-running process.
- ✓ **Convergent Criterion**:
  - The threshold to stop the running process.
- ✓ **Iteration Pass**:
  - The maximum simulation groups(For AI) or running times(For space mapping).

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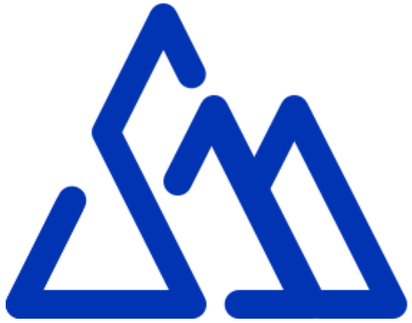

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