MATLAB EXPO

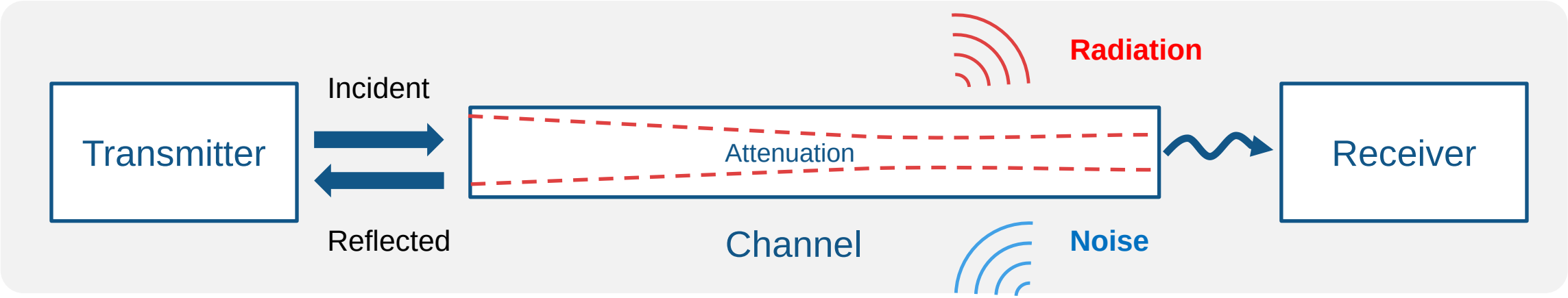
점진적 머신러닝 접근방법을 이용한 신호무결성 시뮬레이션 가속화

MathWorks

관련 자료는 데모부스 모니터 상단의 **QR** 코드를 통해 다운로드 받으실 수 있습니다!

Demo Overview

- **Description:**
  - Signal and power integrity (SI/PI) are essential and interlaced aspects of advanced digital and hybrid electronic system design



  - Signal Integrity remains to be a challenging task and requires the compliance with a variety of specifications
  - The paradigm of the Artificial Intelligence and its applications helps to improve the quality of signals at board, package level which have opened wide fields in the research in signal and power integrity

Key takeaways

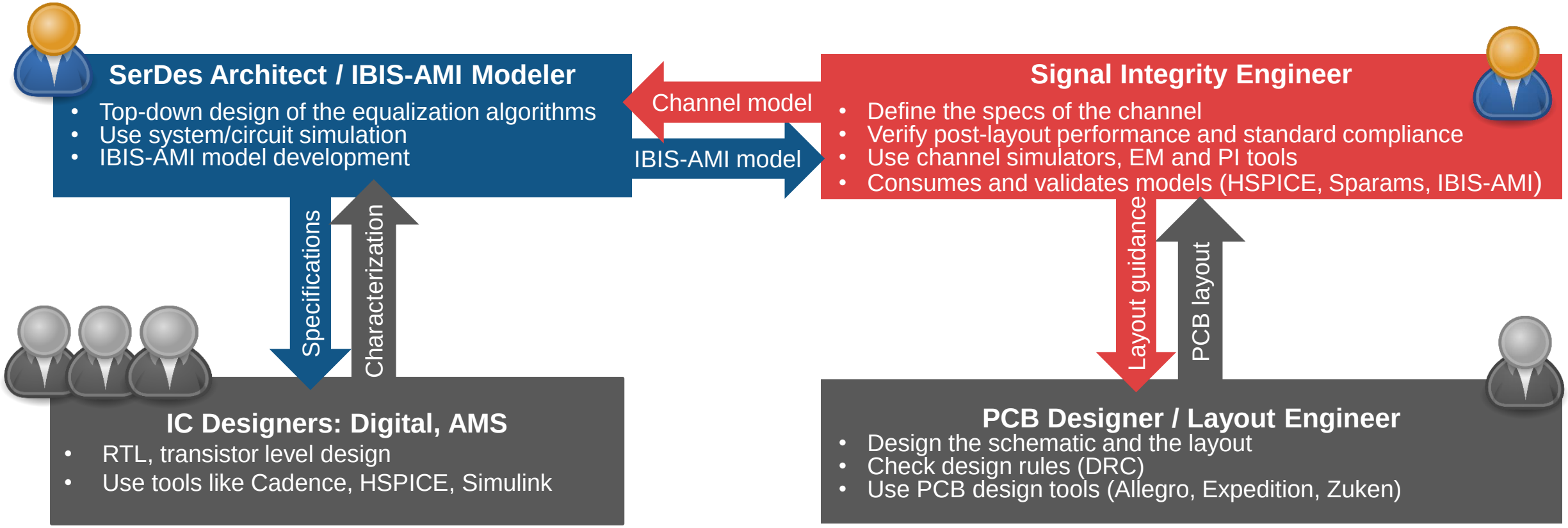
Leverage Machine Learning based workflow on Signal Integrity Analysis for time-to-market

Automatic IBIS-AMI Model Generation

AI + SI without leaving MATLAB

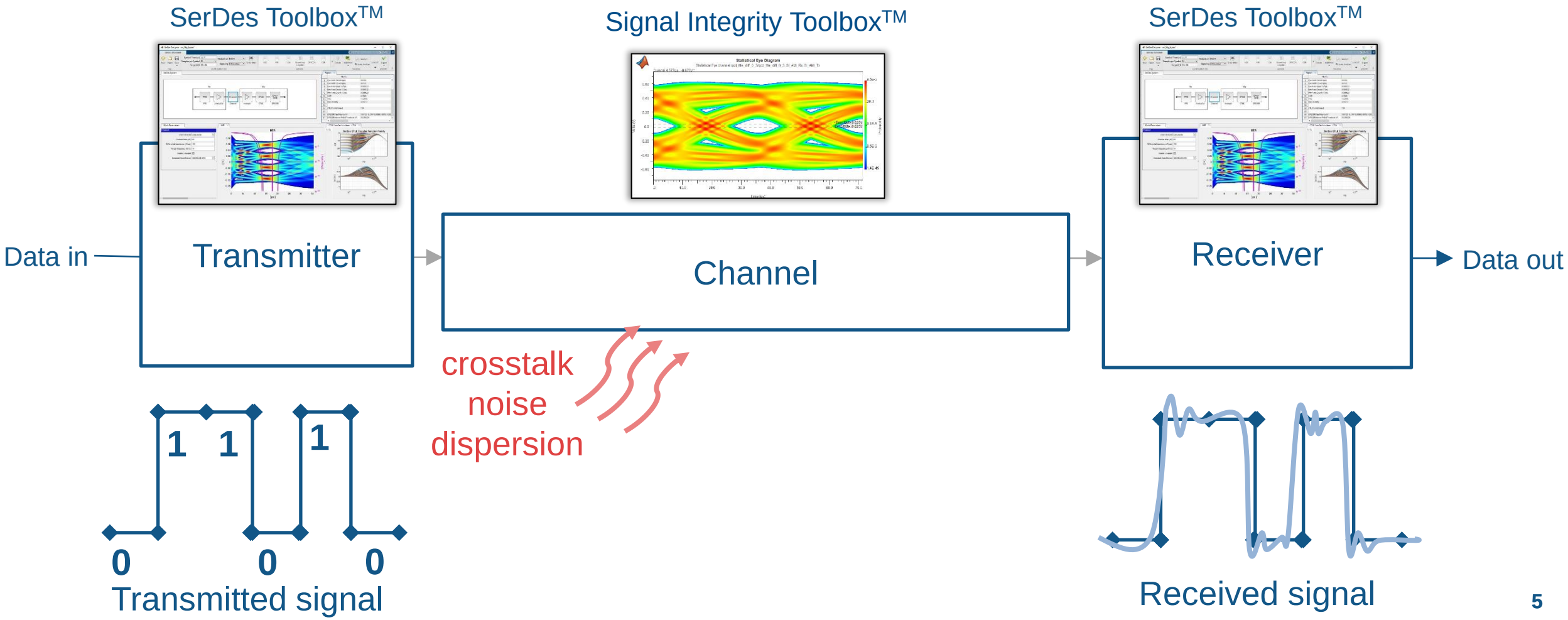
Reduce simulation time

Basic Knowledge - SerDes and Signal Integrity Design and Verification Workflow



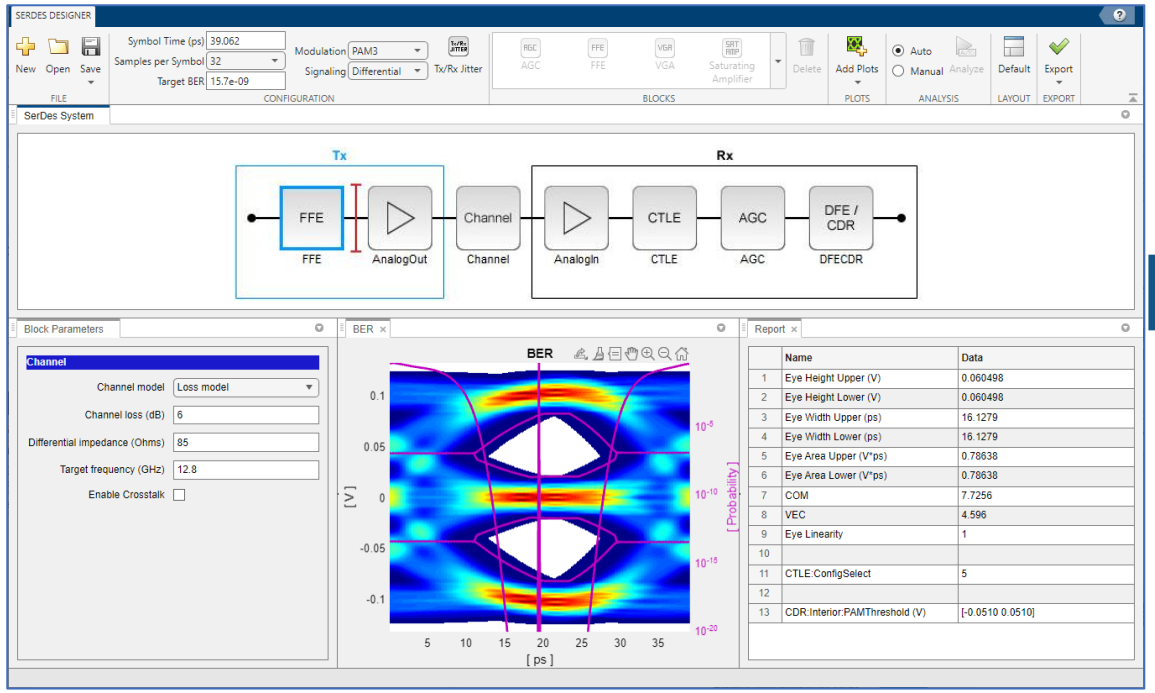
Signal Integrity and PCB analysis

- Signal integrity(SI) is a set of measures of the quality of an electrical signal
- As signal speed increases, signal integrity becomes more important

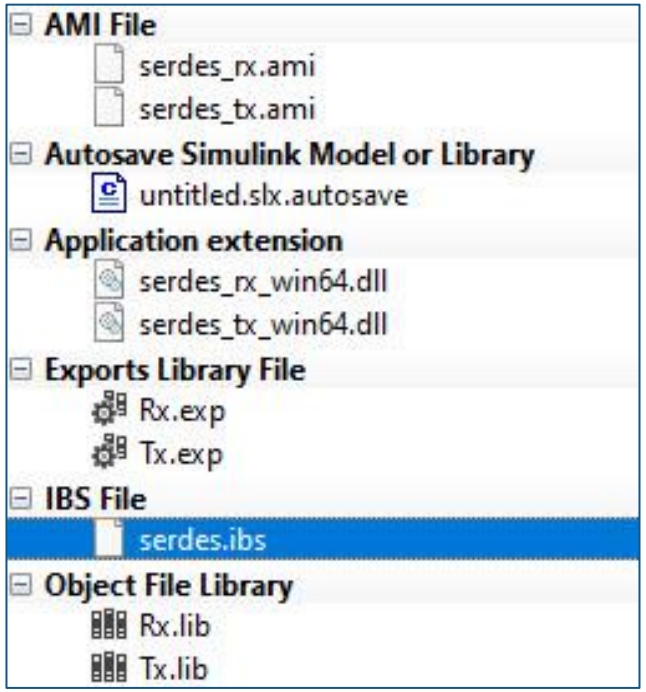


Automatic IBIS-AMI model generation from SerDes System

- Design and analyze SerDes systems
- Import measurements and component specifications
- Perform statistical analysis: Eye diagram, BER, bathtub, pulse response, COM
- Include jitter and cross talk



SerDes Designer App



Generated IBIS-AMI Model

Machine Learning Workflow

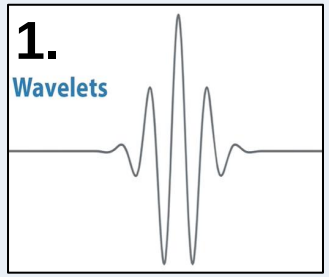
Access Data → **AutoML** → **Integrate Analytics and Deploy**

Preprocess Data | **Develop Predictive Models**

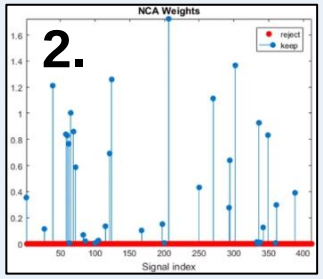
Feature Engineering

Feature Extraction → **Feature Selection** → **Model Training** → **Parameter Tuning**

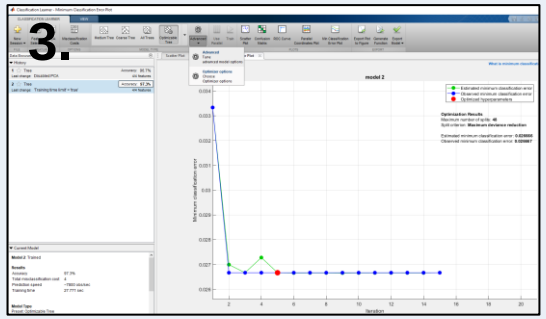
1.



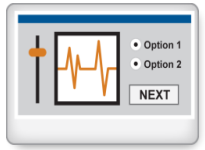
2.



3.



`fitcauto/fitrauto`

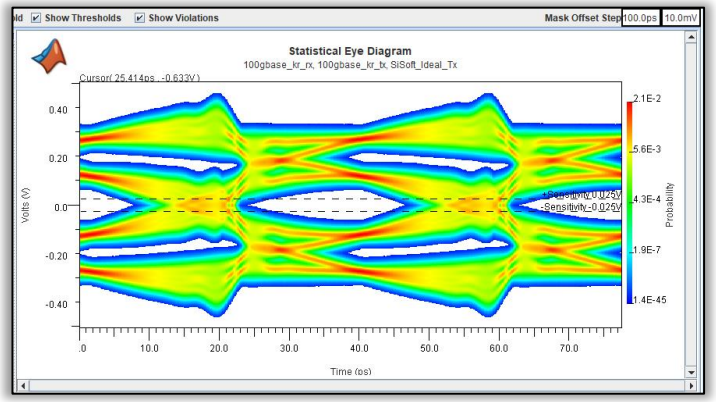


MATLAB Excel .NET .exe C/C++ Java .dll

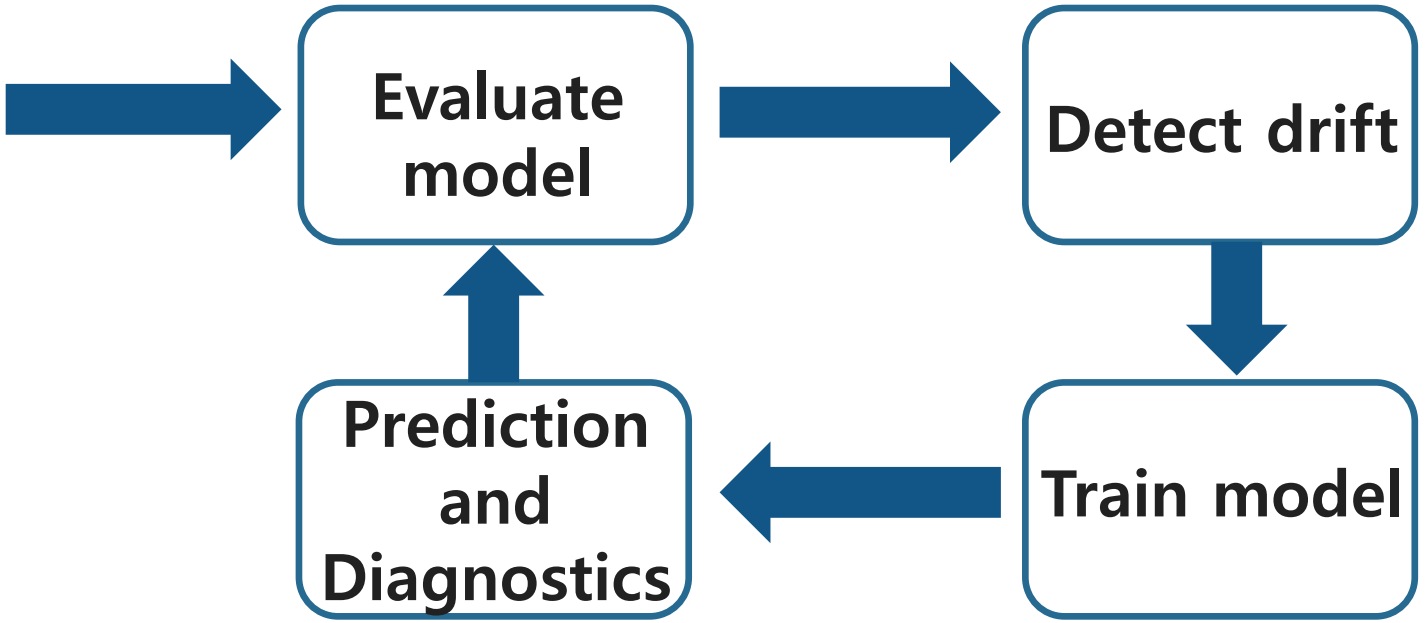
4. `codegen`

What is incremental learning?

- Incremental learning, or online learning, is a branch of machine learning that involves processing incoming data from a data stream—continuously and in real time



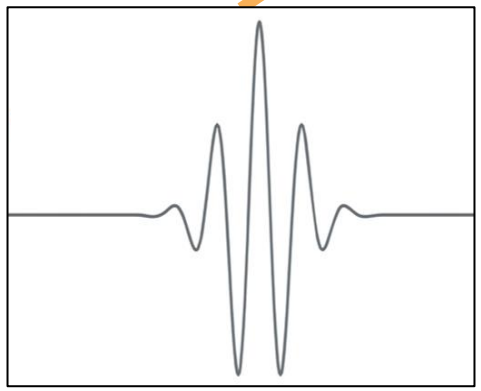
Simulation Data



AutoML for Engineering Applications

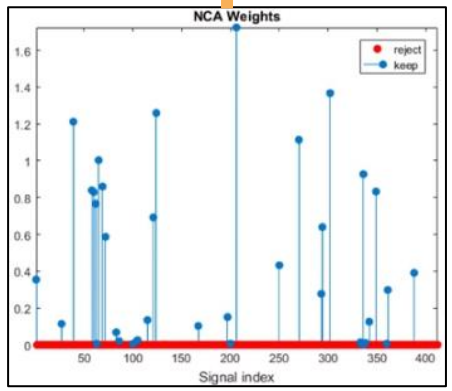
Preprocess Data → **Engineer Features** → **Build & Optimize Model** → **Integrate & Deploy**

1



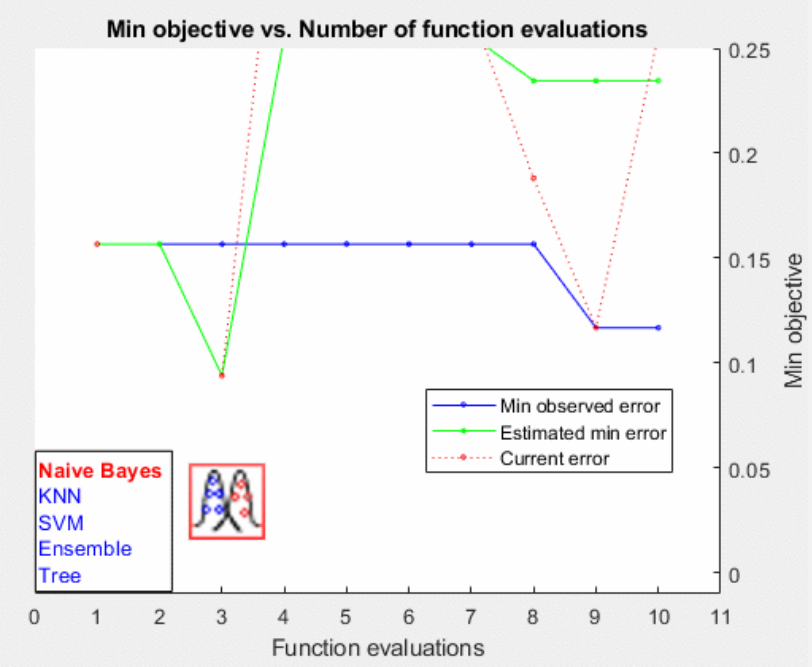
Feature Engineering Techniques

2



Feature Selection

3



Model Selection with Hyperparameter Optimization

AutoML Workflow in MATLAB

1. *Feature generation methods*

2. Get from Signal Integrity toolbox features

   (Generally, Apply Feature Selection techniques)

2. Select and Optimize Model

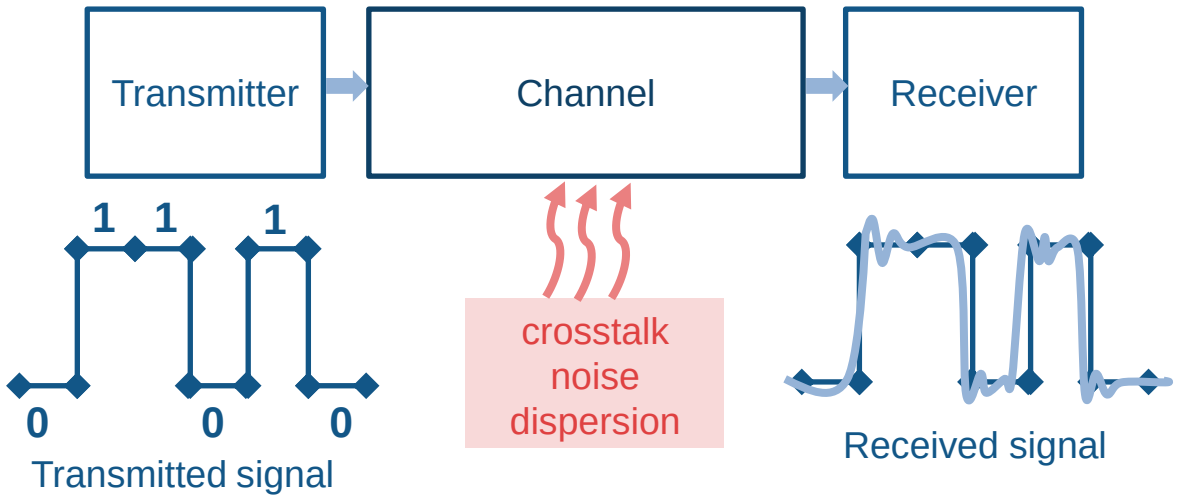
   3a. Train and optimize various models in Learner App

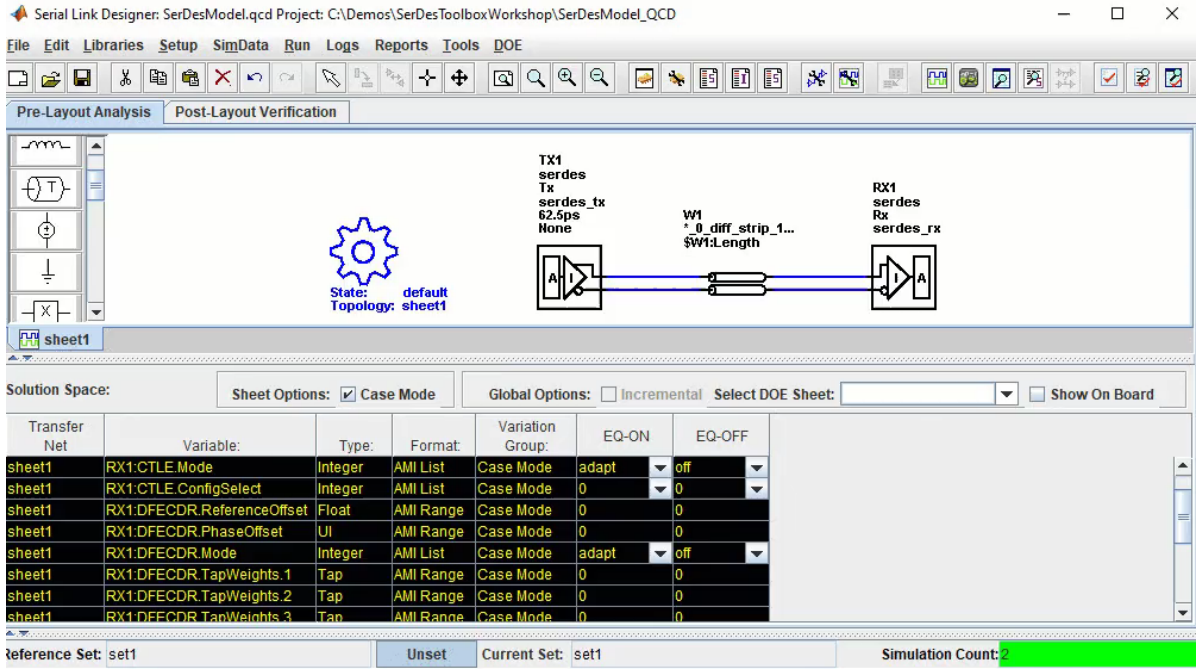
   3b. Or, automatic model selection `fitcauto`/`fitrauto`

4. Generate C-code or Compile to deploy: `codegen`

Problem statement 1:

- Signal Integrity engineers typically perform multimillions of simulations per interface and design specification to validate their design's adherence to expected eye height and eye width
- Especially if the number of parameters we are changing is large, then the time to run each simulation takes large amount of time

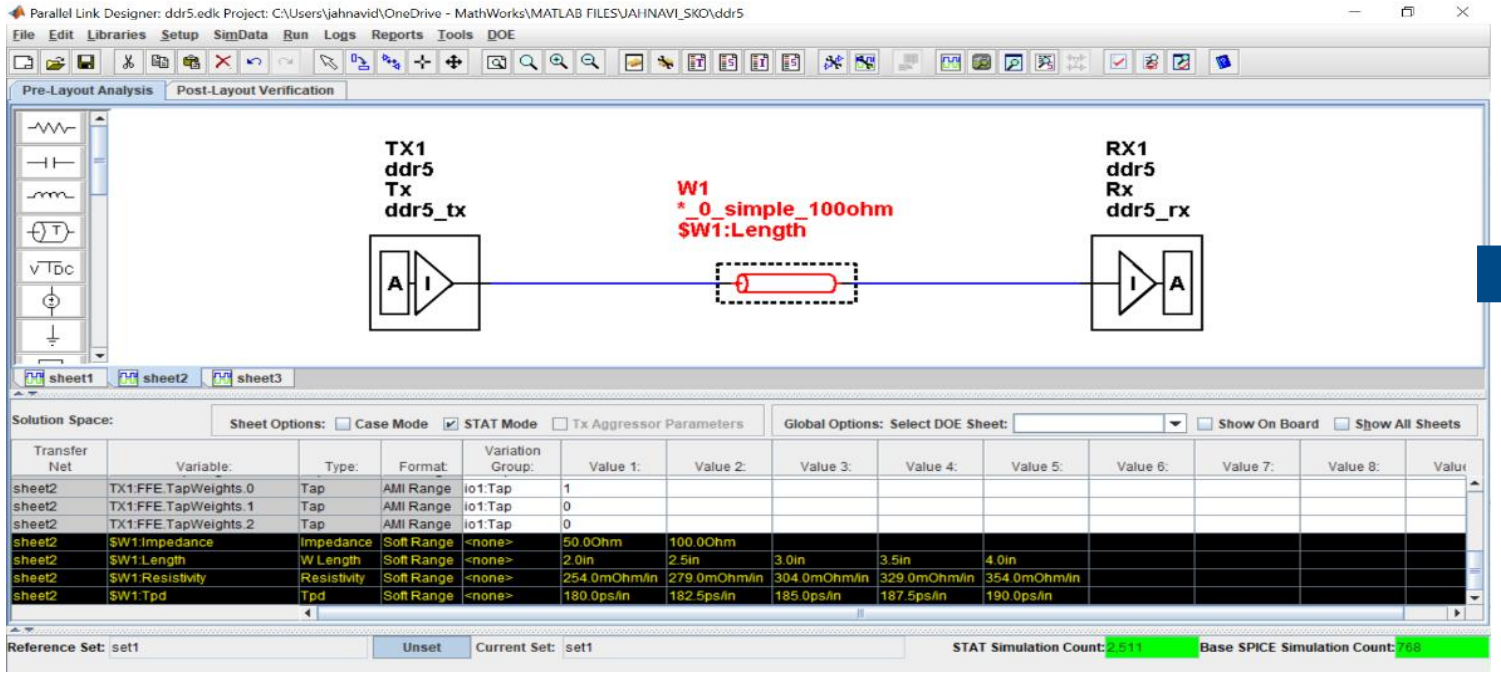




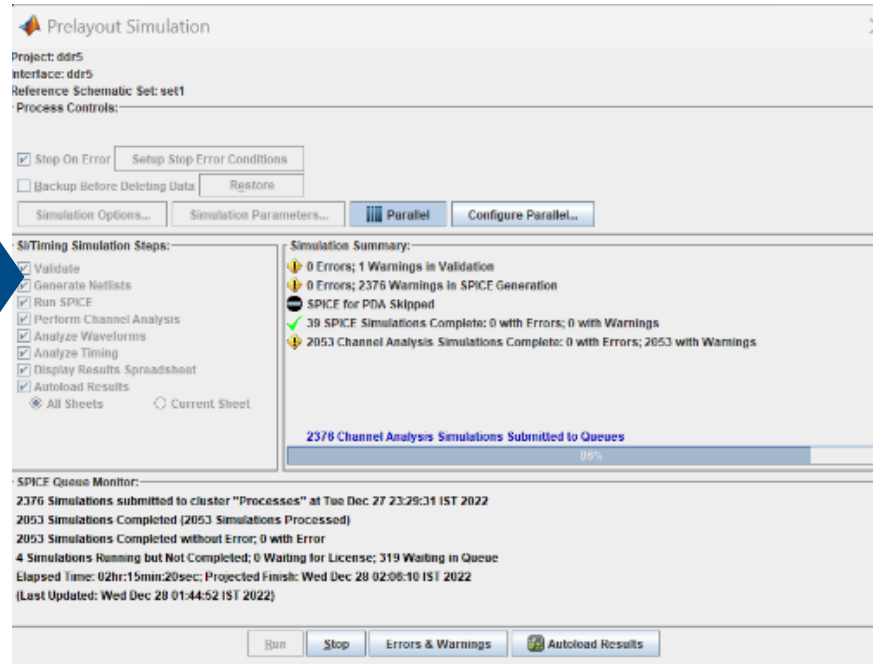
Data collection through simulation

Access Data → **AutoML** → **Integrate Analytics and Deploy**

- **Signal Integrity Toolbox™** provides functions and apps for designing high-speed links
- Generate experiments covering multiple parameters, extract design metrics, and visualize results



Solution space in the Signal Integrity Toolbox

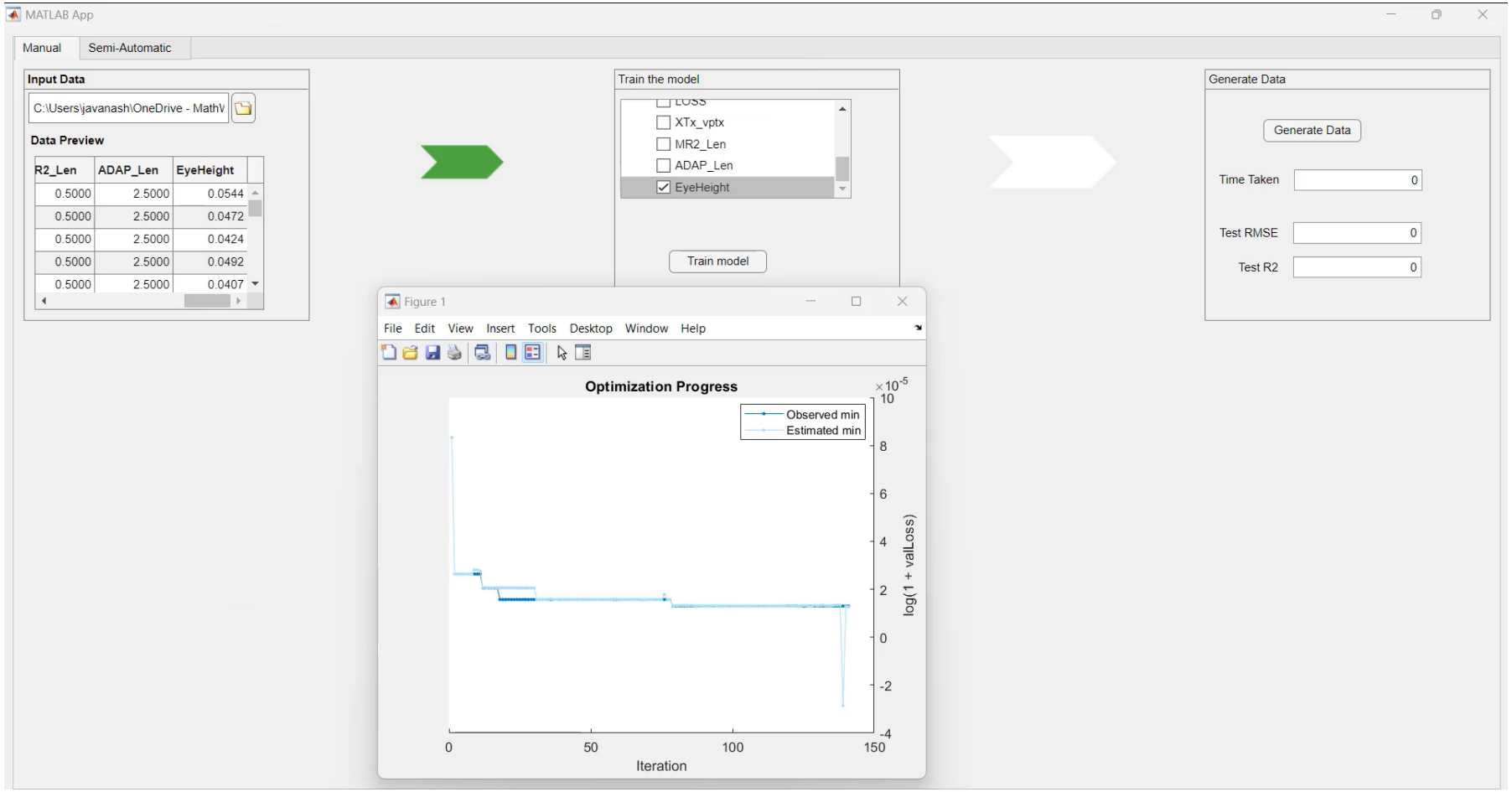


Run multiple simulations

Demo: Incremental Learning using a Custom App (Manual)

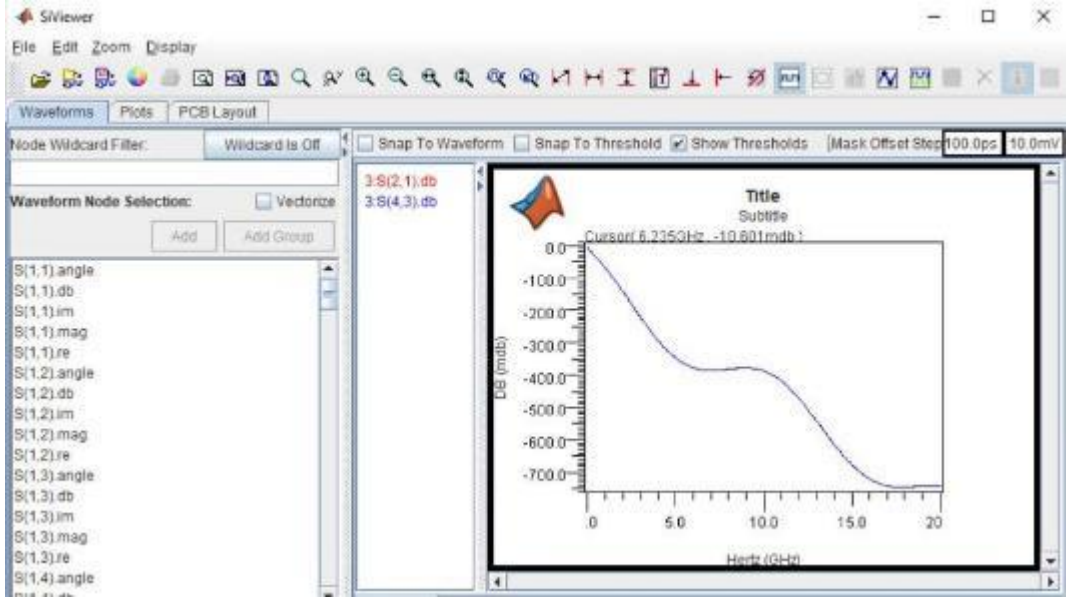
Data import ▶ Train ▶ Test result

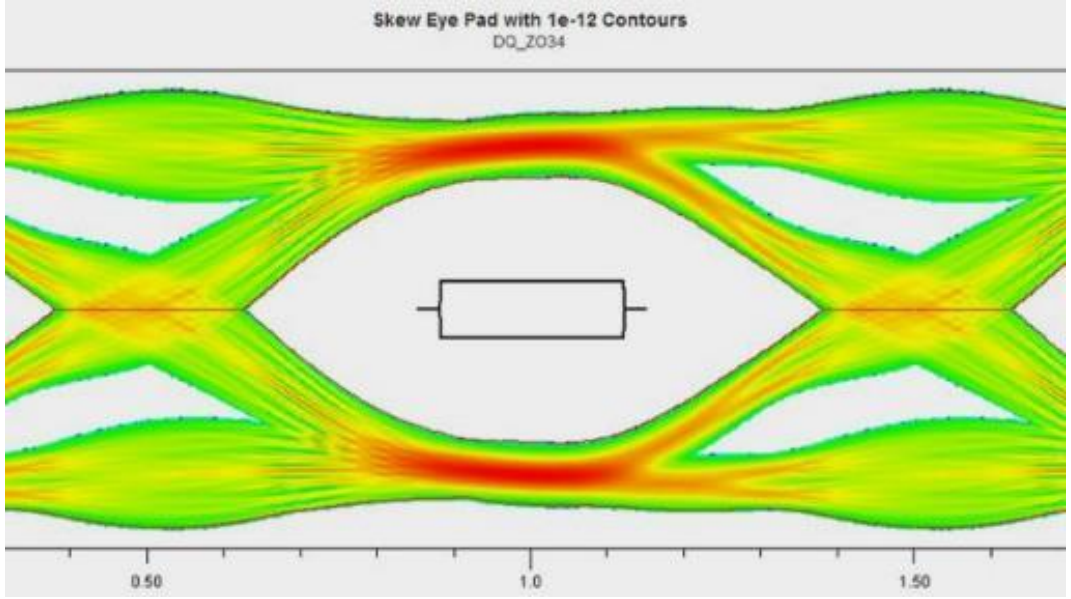
Access Data → **AutoML** → **Integrate Analytics and Deploy**



Problem Statement 2:

- Does it require manual retraining every time?
- Can it be automated by some techniques?

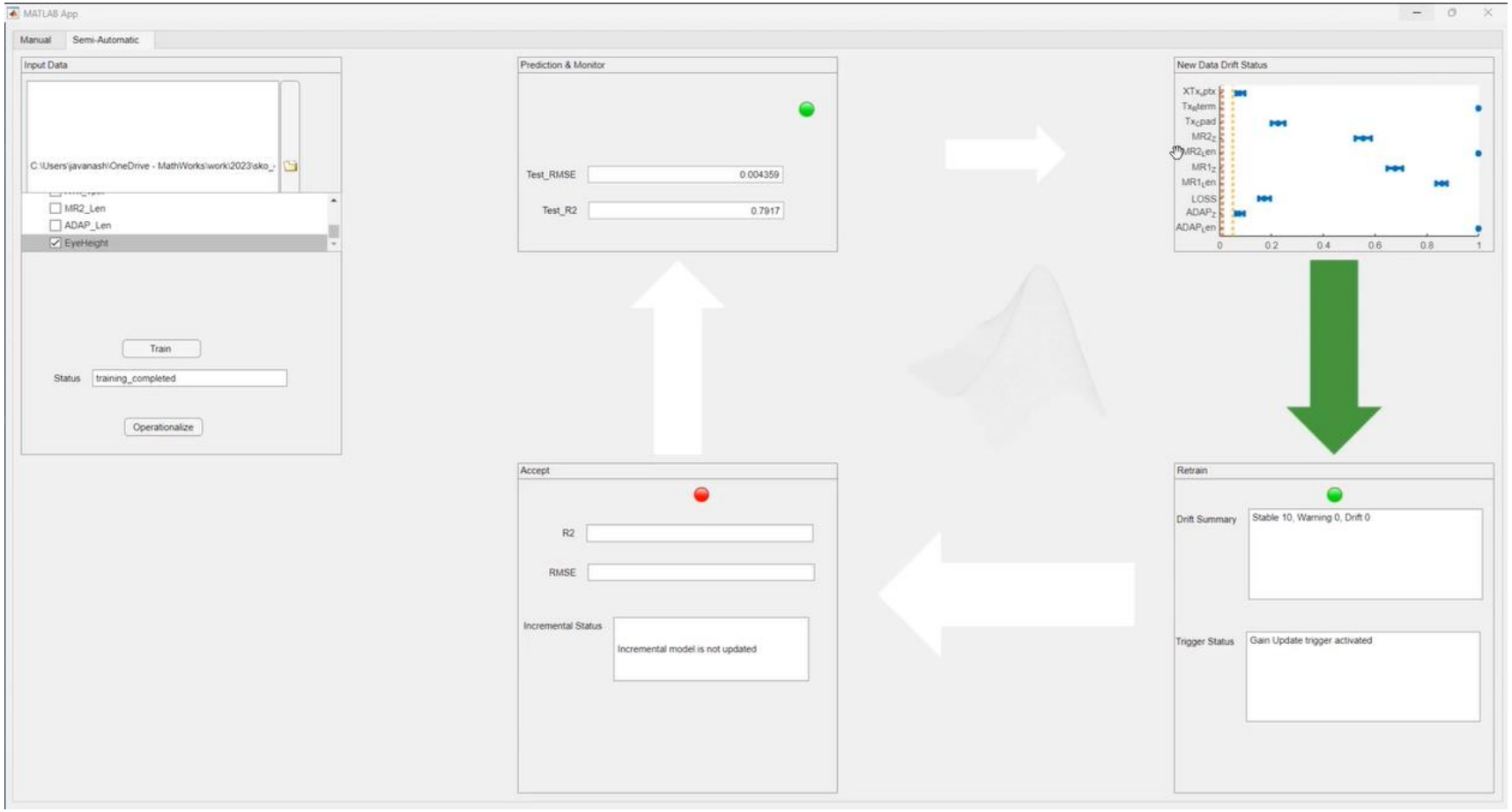




Demo: Incremental Learning using a Custom App (Automatic)

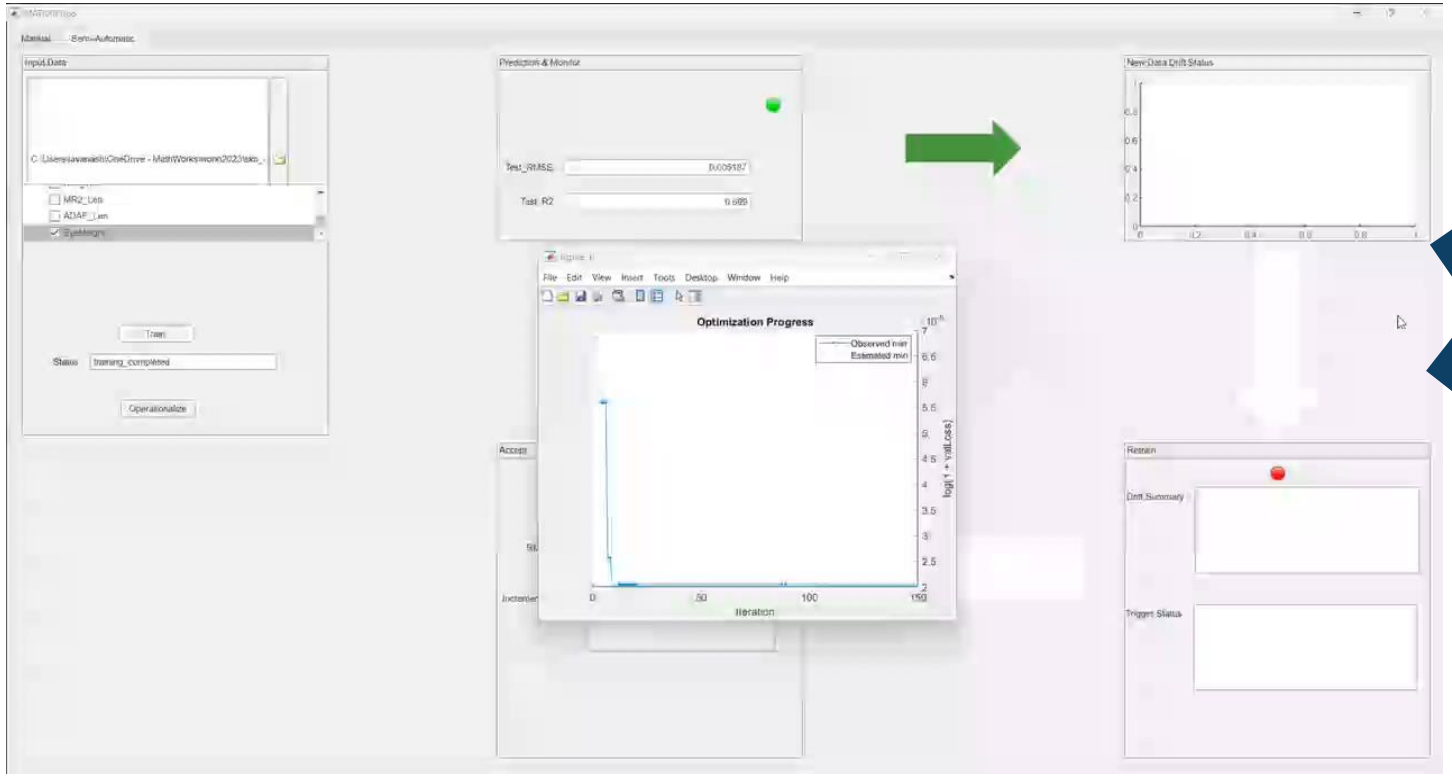
Data import ▶ Evaluate ▶ Drift Detection ▶ Retrain ▶ Prediction

Access Data → **AutoML** → **Integrate Analytics and Deploy**



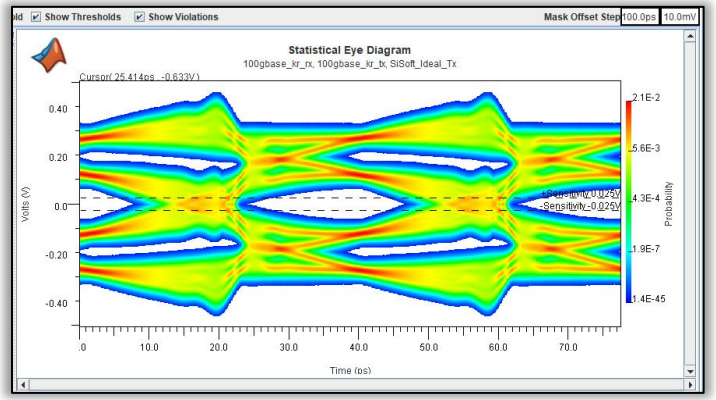
Demo: Code Generation for Deployment

Access Data → AutoML → **Integrate Analytics and Deploy**



Deploy

Optimize



Target Application Areas, Industries, and Products

- Application area(s)
  - AI in Signal Integrity, Surrogate modeling to accelerate the simulation
  - Reduced Order modeling for Semiconductor simulations
- Industries
  - Semiconductor
  - Wireless
- Product(s)
  - SerDes Toolbox
  - Signal Integrity Toolbox
  - Statistics and Machine Learning Toolbox
  - Deep Learning Toolbox
  - Parallel Computing Toolbox
  - MATLAB Compiler

MATLAB EXPO

Thank you

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