# 시스템 시뮬레이션을 위한 인공지능과 모델기반설계의 통합









# Disoss calling...

#### **Two Projects**





Motor Diagnostic

Lane and vehicle detection

# Today's Objective: How to Build AI Functionality into your Systems

#### Learning Algorithms Driving the Al Megatrend



Statistics and Machine Learning Toolbox

**Deep Learning Toolbox** 

**Reinforcement Learning Toolbox** 

# Learning Algorithms Driving the Al Megatrend





Oversteering Detection BMW



**Predictive Maintenance** 

Baker Hughes

6

Digital Twin Atlas Copco



Automatic Ground-Truth Labeling Caterpillar



#### Deep Learning Toolbox



Airbus





Seismic Event Detection Shell

#### Reinforcement Learning Toolbox



Powertrain control Vitesco Technologies

#### Increasing System Complexity

#### Model-Based Design and AI can help build complex systems

System	System Functionality	Subsystem	Subsystem	System Integration
Requirements	and Architecture	Design	Implementation	and Qualification

#### Increasing System Complexity

#### Model-Based Design and AI can help build complex systems



#### Al-driven system design workflow

**Data Preparation** 

Modeling & Training

#### **Simulation & Test**

Deployment

# Integrating AI Models into Simulink



#### Al for algorithm development

- Simulate for system-level testing
- Verify system requirements
- Deploy overall design to CPU, GPU, ECU, FPGA or a mix of targets

#### AI for environment modeling

- Speed up high-fidelity model
- Use data-driven model where mathematical modeling is challenging
- Share component with non-experts in a particular modeling domain or tool

### Case Study 1





Lane and vehicle detection

Why Machine Learning over traditional quantitative/qualitative methods?

- Higher accuracy
- Process may be challenging or impossible to model

#### **Estimate Motor States with Machine Learning**



## How to Integrate Machine Learning?

#### **Built-in Machine Learning blocks**



#### **MATLAB Function Blocks**

- Preprocessing
- Feature Extraction
- Other models

#### Example: SVM Classification block



	Block Parameters: Predict using Classification SVM
SVM Classification (mask) (link)	
Classify observations using support	vector machine (SVM) classifier
Trained Machine Learning Model: Kernel: Linear Score Transform: Logit	
Standardize: Yes	
	Main Data Types
Parameters	
Trained Machine Learning Model Show output Score	svmMdI
	OK Cancel Help Apply

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#### Case Study 2





Motor Diagnostic

#### Lane and vehicle detection

#### Why Deep Learning over traditional Computer Vision?

- No feature engineering
- Higher accuracy

#### Highway Lane Following Model



# Deep Learning Networks in MATLAB/Simulink



# AI Lane Following Model



Intel CPU

#### **CPU** Simulation





#### **GPU** Simulation

#### MATLAB EXPO

#### Run on Jetson AGX Xavier







#### Run on Jetson AGX Xavier





# Import Trained Models



#### User Story - Denso Ten



# www.matlabexpo.com



"A model-based development workflow is essential in order to use AI for control ECUs. Combining the existing control model and the AI model enables us to establish a simulation environment and accelerate product development."

- Natsuki Yokoyama, Denso Ten

#### **Additional AI Examples**





Key Takeaways

# Integrate trained AI models into Simulink

- Test design in simulation
- Code generation
- Integrate AI models from others

감사합니다



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