MathWorks AUTOMOTIVE ENGINEERING CONFERENCE 2020

MATLAB & Simulink
The enterprise engineering platform for AI

Seth DeLand
Integrating AI is a priority for companies today…

**Average number of AI projects expected**

- **2019**: 4 projects
- **2020**: 10 projects
- **2021**: 20 projects
- **2022**: 36 projects

*10x increase in AI projects in three years!*

**Source:** "AI and ML Development Strategies, Motivators and Adoption Challenges," Gartner Research Note, published 19 June 2019

**Gartner Research Circle members with AI/ML projects deployed/in use today, excluding "unsure"**

Source: Gartner AI and ML Development Strategies Survey

Q. How many projects are deployed/in use today? How many projects do you estimate in zero to 12 months, 12 to 24 months, and 24 to 36 months?

ID: 390794
...but AI skills and data quality are major concerns

Top Three Challenges to AI and ML Adoption

1. Skills of your team - 56%
2. Data quality - 34%
3. Functional silos - 13%

Empower domain experts to do their best work

Data selection and prep
Simpler models
Evaluation of results
Failure mode identification
is a **Leader** in the Gartner Magic Quadrant for 2020 Data Science and Machine Learning Platforms

*Gartner Magic Quadrant for Data Science and Machine Learning Platforms, Peter Krensky, Erick Brethenoux, Jim Hare, Carlie Idoine, Alexander Linden, Svetlana Sicular, 11 February 2020.*

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AI-driven system design workflow

1. Data Preparation
2. AI Modeling
3. Simulation and Test
4. Deployment
AI-driven system design workflow

1. Data Preparation
   - Data cleansing and preparation
   - Human insight
   - Simulation-generated data

2. AI Modeling
   - Model design and tuning
   - Hardware accelerated training
   - Interoperability

3. Simulation and Test
   - Integration with complex systems
   - System simulation
   - System verification and validation

4. Deployment
   - Embedded devices
   - Enterprise systems
   - Edge, cloud, desktop
Dramatically reduce human supervision and development time

- Partnered with MathWorks on their big data and machine/deep learning infrastructure
- Automatically ground-truths and labels data, reducing the need for human supervision and development time
- Tight integration with MATLAB for machine/deep learning, visualization, and code generation

“We were spending way too much time hand-labeling our data…automatic detection and labeling of our data has been a tremendous advantage in efficiency.”

— Larry Mianzo, Caterpillar
Automated labeling Apps save you weeks to months
Generate synthetic data from Simulink to improve your datasets

- Radar Signal Simulation and Processing for Automated Driving
  Automated Driving Toolbox
  Phased Array System Toolbox

- Visualize Automated Parking Valet Using 3D Simulation
  Automated Driving Toolbox
  Simulink

- Simulate Lidar Sensor Perception Algorithm
  Automated Driving Toolbox
  Simulink
  Computer Vision Toolbox
Suzuki leverages Machine Learning as part of a MATLAB-based workflow to optimize control parameters

Optimize control parameters to achieve “Drivability feel”
- Developed machine learning model to predict drivability score
- Optimize LUT parameters taking drivability into account

Challenges
- Model creation required lots of trial and error, need to iterate quickly was important

AI modeling Apps automate training, tuning, visualization...

- **Deep Network Designer** app to build, visualize, and edit deep learning networks.
- **Classification Learner** app to try different classifiers and find the best fit for data sets.
- **Experiment Manager** app to run deep learning experiments to train networks and compare results.
Accelerate AI training on GPUs, cloud, and datacenter resources without specialized programming
Access AI models from the broader AI community
Integrate AI into system-wide context, simulate before moving to hardware, and verify effectiveness
Use Simulink for rapid design iteration and testing

“Simulink + ROS allowed us to deploy a Level 3 autonomous vehicle in less than three months.”
— Alan Mond, Voyage
Simulate rare system failures to avoid them in the real world
Deep experience in safety-critical certification enables us to drive new standards for AI

**Today**

- IEC Certification Kit for ISO 26262 and IEC 61508
  - Qualify code generation and verification tools for ISO 26262 and IEC 61508 certification

**Tomorrow**

- EUROCAE WG-114 “Artificial Intelligence”
- SAE G-34 “Artificial Intelligence in Aviation”
AI models are useful everywhere

1. Data Preparation
2. AI Modeling
3. Simulation and Test
4. Deployment
BMW Detects Oversteer with Machine Learning

Detect vehicle oversteer situations more accurately to improve stability control system performance
- Use machine learning to identify oversteer

Challenges
- Difficult to detect oversteer, requires many sensors
- Implementing machine learning on ECU

Data sources
- Logged CAN bus data and oversteer records

Source: MATLAB Technical Article: Detecting Oversteering in BMW Automobiles with Machine Learning
Tobias Freudling, BMW Group
Deploy to any processor with zero coding errors
Deploy to enterprise IT infrastructure
Integrating models with enterprise IT infrastructure

1. Data Preparation
2. AI Modeling
3. Simulation and Test
4. Deployment
Why MATLAB and Simulink for Artificial Intelligence?

- Empower domain experts, including those with limited AI experience
- Build better data sets with domain-specific tools
- Use modeling and simulation to tackle integration challenges and reduce risk
- Deploy AI models to wherever you need them

1. Data Preparation
   - Data cleansing and preparation
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   - Simulation-generated data

2. AI Modeling
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   - Hardware accelerated training
   - Interoperability

3. Simulation and Test
   - Integration with complex systems
   - System simulation
   - System verification and validation

4. Deployment
   - Embedded devices
   - System simulation
   - Edge, cloud, desktop
Augment Your Knowledge by Upskilling in AI

Get Started for Free

- MATLAB Onramp
  Get started quickly with the basics of MATLAB®.
  » Details and launch

- Machine Learning Onramp
  An interactive introduction to practical machine learning methods for classification problems.
  » Details and launch

- Deep Learning Onramp
  Get started with deep learning techniques to perform image recognition.
  » Details and launch

Training Courses

- MATLAB Fundamentals (3 days)
- MATLAB for Data Processing and Visualization (1 day)
  Processing Big Data with MATLAB (1 day)
- Statistical Methods in MATLAB (2 days)
- Machine Learning with MATLAB (2 days)
- Signal Preprocessing and Feature Extraction with MATLAB (1 day)
- Deep Learning with MATLAB (2 days)
- Accelerating and Parallelizing MATLAB Code (2 days)

Practical Data Science with MATLAB Specialization

- Exploratory Data Analysis
- Data Processing and Feature Engineering
- Predictive Modeling and Machine Learning
- Data Science Project
Empower domain experts to do their best work
<table>
<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
<th>Presenter</th>
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<tr>
<td>12:50</td>
<td>Welcome and Introduction</td>
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<tr>
<td>1:00</td>
<td>Enterprise Engineering Platform for AI</td>
<td>Seth DeLand, MathWorks</td>
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<td>1:25</td>
<td>Using MATLAB on Apache Spark for ADAS Feature Usage Analysis and Scenario Generation</td>
<td>Sanjay Abhyankar, Ford Motor Company</td>
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<td>1:50</td>
<td>Tackling Fleet Test Data with MATLAB</td>
<td>Will Wilson, MathWorks</td>
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<td>2:10</td>
<td>Machine Learning Case Studies for Quality Evaluations</td>
<td>Marc Harris, TimkenSteel</td>
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<td>2:30</td>
<td>A Perspective on Deploying Reinforcement Learning to Augment Classic Control Design</td>
<td>Ali Borhan, Cummins</td>
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<td>2:50</td>
<td>Advanced Tool Capabilities for Embedding Machine Learning into ECUs</td>
<td>Gokhan Atinc, MathWorks</td>
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<tr>
<td>3:10</td>
<td>Big Data Methods and Computation with Predictive Life Assessments</td>
<td>Meaghan Kosmatka, John Deere</td>
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<tr>
<td>3:30</td>
<td>Making MATLAB Data Analytics Accessible Across Enterprise</td>
<td>Arvind Hosagrahara, MathWorks</td>
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<td>3:50</td>
<td>Technology showcase</td>
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<td>4:20</td>
<td>End of Event</td>
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1. What are your biggest challenges in adopting AI?
   - Lack of data or not "the right" data
   - Team lacks the required skillset
   - Not enough bandwidth to investigate AI
   - Lack clarity of relevant AI use-cases

2. Which part of the AI workflow are you most interested in learning more about?
   a) Data Preparation for AI
   b) Building AI Models
   c) Simulation and Test of AI Models
   d) Deployment of AI Models