The Rise of Engineering-Driven Analytics

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The Rise of Engineering-Driven Analytics
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Analytics are now pervasive

Apply robust, statistically-motivated methods to data produced from complex systems to understand what has happened and why,

predict what will happen, and

suggest decisions or actions.
Analytics are now pervasive

Apply robust, statistically-motivated methods to data produced from complex systems to understand what has happened and why,

predict what will happen, and

automate decisions or actions.
Analytics are pervasive – *Why Now?*

**We have data**
- Engineering
- Business
- Transactional

**We have compute**
- Desktop
  - Multicore, GPU
- Clusters
- Cloud computing

**We know how**
- Neural Networks
- Classification
- Clustering
- Regression
- ...and much more...
The Rise of Engineering-Driven Analytics
50 km/h - sudden brake
Example – Scania

Automatic emergency braking using sensor fusion and analytics

Sensor fusion

Two sensors -> One "truth"

Sensors have different advantages

- Radar
  - Range (longitudinal)
  - Relative velocity
  - Solid object reflection
    - No shapes
    - Lateral position

- Camera
  - Object type
  - Object width
  - Lateral position
    - Range
    - Optical illusions
Model Based Design and Machine Learning Combined

Vehicle logs of video and radar data

Predictive Model deployed on vehicle

Machine learning to develop fusion algorithms for situation detection

2.2. Model-Based Design in der industriellen Praxis

Model Based Design to simulate, test and perfect the application

MATLAB EXPO 2016
Consider the **Data** in Data Analytics

**Engineering Data**
- Video
- Audio
- Images
- Sensor

**Business Data**
- Social profile
- Geolocation
- Keystroke logs
- Transactions

**Level of Industry / User Adoption**

*Source: Gartner Big Data Industry Insights, March 2016*
Architecture of an analytics system

Data from business systems

Data from instruments and connected systems

MATLAB Integrates in Embedded System and Enterprise IT Workflows

Predictive Model deployed in smart systems using Model-Based Design

Predictive Model deployed on cloud and business systems
Example – BuildingIQ
Adaptive building energy management
Building IQ

25% cost reduction

degrees Celsius

Actual temperature

Comfort bounds

Temperature setpoint

24°C

21°C

0:00  8:00 am  6:00 pm  0:00
Real-time, closed-loop optimization algorithms

DATA - Billions
Physics, energy costs, ambient temperature, operation schedule

Analytics and Machine Learning
plus system identification, control theory & more

MATLAB Toolboxes Just Work – and work together!

Predictive Model
deployed on cloud with client system and real-time data feeds

Current energy costs & demand
Weather Feeds
We could rapidly translate our prototypes into production algorithms that deal reliably with real-world noise and uncertainty.

Borislav Savkovic, BuildingIQ

Why MATLAB?

- Robust numerical algorithms
- Extensive visualization and analytics tools
- Industry-robust and **reliable mathematical optimization** routines
  - Good object-oriented framework
  - Ability to interface with Java (for backend work)
  - Running MATLAB in the cloud in **production**
  - Unit-testing framework

MATLAB Impeccable Numerics for Trusted Results
We could rapidly translate our prototypes into production algorithms that deal reliably with real-world noise and uncertainty.

Borislav Savkovic, BuildingIQ
Analytics in e-commerce

Site makes recommendations using Image Processing techniques on the fashion photos.
Analytics in e-commerce

Use Image Processing to add image data to the model, improving performance

IMPROVED Predictive Model

Offer to Customer
The Rise of Engineering-Driven Analytics

- Automotive
- Off-highway vehicles
- Aeronautics
- Retail
- Finance
- Healthcare management
- Internet
- Industrial Automation
- Oil & Gas
- Medical Devices
- Clean Energy
The Data Scientist

- Domain expertise
- Coding and integration skills
- Statistical and mathematical knowledge
MATLAB lets you be your own data scientist

MATLAB is Designed and Documented to be Easy for Engineers and Scientists to Use
Classification Learner App
in Statistics and Machine Learning Toolbox
MATLAB Apps Enhance Productivity

- Apps help new users learn
- Save time and reduce errors by automating steps
- Remind experienced users of alternative options
- Generate code to support automation of common tasks
TSMC Data Analytics Student Contest
Use process control data to improve semiconductor yields

- Wafer Data in Hadoop
- 21 teams competed
- MATLAB used by winning team and 2nd place team
IoT open data platform for students and makers

Built-in MATLAB analysis

www.thingspeak.com
How Does MATLAB Apply?

Big Data
- Engineering
- Business
- Transactional

Compute Power
- Desktop - Multicore, GPU
- Clusters
- Cloud computing
- Hadoop

Machine Learning
- Neural Networks
- Classification
- Clustering
- Regression
- ...and much more...
Native support for engineering data

NEW for MATLAB

Audio System Toolbox R2016a
Vision HDL Toolbox R2015a
In MATLAB

- **Datastore** R2014b
  text, image, video, Excel files, ...
- **Mapreduce** R2014b
- Database interfaces
- Streaming
In MATLAB

- **Hadoop support** R2014b
- **Multicore & GPU**
- **MATLAB Distributed Computing Server**
- **MATLAB Production Server**

MATLAB is fast:
- heavily optimized libraries
- JIT compiled
- takes advantage of the compute power you have
In MATLAB

- **Datastore** R2014b
  text, image, video, Excel files, ...
- **Mapreduce** R2014b
- **Hadoop support** R2014b
- **Scalable performance and production deployment**
- **Classification Learner App** R2015a
- **CNNs for Deep learning** R2016a
- **Machine learning with code generation**
Predictive Maintenance for Polymer Production Machines

Classification using Statistics, Machine Learning, and Neural Networks

1.2. Data Science mit MATLAB
1 Big Opportunity for Analytics in Engineering and Science
- Autonomous Systems
- Predictive Maintenance
- Fleet and Asset Analytics
- Prognostics and Health Monitoring
- Internet Of Things (IoT)
- Operational Analytics
- Adaptive Control
- Supply Chain
- Risk Analysis

2 MATLAB Let’s You Use Analytics in Your Workflow
- Familiar Environment
- Easy to Learn and Use
- Production Quality
- Integration with Simulink and Model Based Design
- Deployment to IT/Cloud

Can you make your ____ smarter?
The Rise of Engineering-Driven Analytics

Your Data has Value

*Use it!*