Behind Today’s Trends
The Technologies Driving Change

Sameer M. Prabhu, Ph. D.
Industry Marketing Director
MathWorks
Big Data
Cloud Computing
Wearable Tech
Internet of Things
MOOC
Industry 4.0
Trends from 2009

Social Computing
Smart Phones
Complex Event Processing
Software as a Service
Executable Internet
Google Trends over Time

- Big Data
- MOOC
- Software as a Service
- Social Computing

TRENDS
COME AND GO
Research & Development

R&D Intensity in OECD countries and other economies

Source: OECD Main Science and Technology Indicators Database, 2014/1.
Research & Development

R&D investment by the world’s top 2000 companies

Source: The 2013 EU Industrial R&D Investment Scoreboard
European Commission, JRC/DG RTD.
Long-Term Transformations Driving Changes in Markets and Technical Applications

- Spreading into every industry
- Complexifying systems
- Speeding up development cycles
- Intensifying applied research
- Challenging the education systems to produce those skillsets

- Our strategy, based on what those transformations imply for the long term
Algorithms in everything

Hardware in specialized form factors

Connected chips, devices & systems

People computing anywhere
ALGORITHMS
IN EVERYTHING
Intel predicts 170 billion transistors per person in the world by 2015.
% Compute Kalman Gain:
W = P*M*inv(M*P*M' + R);

% Update estimate
xhat = xhat + W*residual;

% Update Covariance Matrix
P = (eye(4)-W*M)*P*(eye(4)-W*M)' + W*R*W';
% Predicted state and covariance
x_prd = A * x_est;
p_prd = A * p_est * A' + Q;

% Estimation
S = H * p_prd' * H' + R;
H = H * p_prd';
klm_gain = (S \ B)';

% Estimated state and covariance
x_est = x_prd + klm_gain * (z - H * x_prd);
p_est = p_prd - klm_gain * H * p_prd;

% Compute the estimated measurements
y = H * x_est;
NEW in Release 2013b

MATLAB System block

- Incorporate MATLAB System objects into a Simulink model
  - System objects simplify the implementation of stream processing
  - Optimized to process large streams of data
- Signal processing algorithm development
- Basic math
- Advanced digital signal processing
- Rapid iteration for development and testing
- Growing library of algorithms

DSP System Toolbox

Medical Imaging
Tools for analyzing and visualizing medical images, and for developing advanced imaging algorithms.
» Learn more

Diagnostic and Therapeutic Devices
Robust and reliable closed-loop control systems for devices that replace critical physiological functionalities.
» Learn more

FDA-MathWorks Research and Collaboration Agreement Summary
» Learn more

Medical Software Validation
Validation tools for ensuring your software is safe from catastrophic run-time errors.
» Learn more

http://www.mathworks.com/medical-devices/
Phased Array System Toolbox

Algorithm development
• Antenna array design and analysis
• Radar signal generation
• Detection and signal processing algorithms

Radar system modeling
• Performance testing
• Regulatory compliance
• What-if analysis

NEW in Release 2014b
Block library for phased array system design in Simulink
Large Collection of Function Libraries
Advanced Driver Assistance Systems

Adaptive cruise control + Stop&Go
Intelligent headlamp control
Blind spot detection
Lane change assist
Forward collision warning
Emergency brake assist
Traffic signal recognition
Lane departure warning
Lane keeping system
Advanced emergency braking system
Back-up aid

From Advance Driver Assistance Systems Market, Drivers, Functions, Continental AG, KSAE 2011
Advanced Driver Assistance Systems

Coder Code Performance

Conclusions:

✓ Reliable. Coder code 
✓ Efficient. This improv algorithm with hand c.
✓ Easy to integrate.

Summary

➢ Radar Sensors’ Alignment Algorithm design, simulation, data analysis, and implementation are done together within Matlab only;
➢ One algorithm engineer can completely responsible with one algorithm block. Save time to coordinate with software engineer.
➢ In the future, Matlab plus Coder will be popular in algorithm development area.
Advanced Driver Assistance Systems

Evaluation

MATLAB Toolchain
- Image Processing Toolbox
- Signal Processing Toolbox
- Statistics Toolbox
- Curve Fitting Toolbox
- Parallel Computing Toolbox

Summary

› MATLAB is used in daily work for development and evaluation of driver assistance functions
› Prototypes are designed with MATLAB for predevelopment and proof of concept
› Data management, evaluation, and interactive analysis are supported by MATLAB tools and GUIs
› Traffic Sign Recognition and other functions make high use of MATLAB tools
› MATLAB and its established features
  › reduces our tool development efforts,
  › accelerates our simulation cost,
  › and allows reliable, repeatable and accurate parameter optimizations
› Engineers having good MATLAB programming skills are highly requested

Traffic sign recognition in driver assistance systems - MATLAB at Continental
Dr Alexander Behrens, Continental, MATLAB Expo, July 2014, Munich, Germany.
NEW in Release 2014a

Control System Tuner App

- Tune fixed-structure controllers in Simulink
- Specify blocks to tune
- Add tuning goals
- Visualize tuning results
- Update tuned Simulink blocks from app
User-Created Apps
ALGORITHMS
IN EVERYTHING

- Unified textual & graphical programming
- Portfolio of libraries
- Apps and resources on MATLAB Central
HARDWARE
IN SPECIALIZED FORM FACTORS
RUN YOUR ALGORITHM
Power plants 100s

Cars 1,000,000s

Planes 1,000s
NEW in Release 2014a

Simulink Real-Time

*Build, run, and test real-time applications*

"Simulinkのバーチャル環境を現実の世界へ" @ 17:30
“...with Model-Based Design and rapid real-time prototyping, we maintain the product development pace that our business demands.”

- Run algorithms on real-time hardware
  - Real-time testing and verification

Simulink Real-Time
Release 2014a

- Design iteration and testing in minutes
- Higher software quality
The Rise of Low-Cost Hardware for the Masses

Arduino
- 300,000+ commercially produced
- $30 (UNO), $55 (Mega 2560), $55 (Due)

Raspberry Pi
- 2.5+ million shipped
- $35 (Model B)

LEGO Mindstorms EV3
- 3rd generation from LEGO Mindstorms
- $350 (for base set)
Hardware support packages

- Get connected and running quickly
- 150 packages today, for ARM, Texas Instruments, iPhone, Android, Kinect, and more

NEW in Release 2014b

MathWorks.com/hardware
Magnus Egerstedt

Khepera 3
HARDWARE IN SPECIALIZED FORM FACTORS

- MATLAB algorithms in production systems
- Code generation for prototyping and embedded
- Connecting to low-cost hardware for the masses
CONNECTED
CHIPS, DEVICES, & SYSTEMS
Internet of Things

Growth in Global Connectivity

- "Place" connectivity
- "People" connectivity via mobile devices
- "Thing" connectivity

THINGS 50+ billion
PEOPLE 5 billion
PLACES 1 billion

© 2010 Ericsson AB – from Joshipura, Arpit, “Infrastructure Innovation - Can the Challenge be met?” Global Semiconductor Alliance, September 2010
## Big Data in Energy Production

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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<tbody>
<tr>
<td>Megabyte</td>
<td>1,000,000 bytes (million)</td>
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<tr>
<td>Gigabyte</td>
<td>1,000,000,000 bytes (billion)</td>
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### Turbine (machine)

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
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<tbody>
<tr>
<td>Analytics</td>
<td>Asset optimization</td>
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<td>Data quantity</td>
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<tr>
<td>Data frequency</td>
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<table>
<thead>
<tr>
<th>Data quantity</th>
<th>17 MB/day</th>
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<tbody>
<tr>
<td></td>
<td>6.3 GB/year</td>
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<tr>
<td>Data frequency</td>
<td>4.1 GB/day</td>
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<td></td>
<td>1.5 TB/year</td>
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<td>0.7 TB/day</td>
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<tr>
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<td>0.25 PB/year</td>
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</table>

Source: General Electric

"インテージ株式会社: 価格弾力性分析におけるMATLAB活用事例の紹介" @17:10
Big Data in Many Industries

Exabyte 1,000,000,000,000,000,000,000 bytes (billion billion)

ENERGY
Smart grid

AUTO
Fleet data will influence vehicle design

AERO
Maintenance, reliability

FINANCE
Fraud detection

BIOTECH
Instrumented humans
Big Data in MATLAB

Memory & Disk Management
- 64-bit
- Memory Mapped Variables
- Disk Variables
- Intrinsic Multicore Math
- Image Block Processing

Processing Speed
- GPU Computing
- Parallel Computing
- Cloud Computing
- Distributed Arrays

Algorithms
- Streaming Algorithms
- Machine Learning
PROCESSING OPTIONS

- MATLAB RESTful interface to Cluster
- MATLAB Hadoop Streaming
- NoSQL connector (e.g. mongo)
- MATLAB / Java App accessing Cluster
- MATLAB Map-Reduce Components
CONNECTED CHIPS, DEVICES, & SYSTEMS

- Memory management
- Computing power
- Advanced algorithms
PEOPLE COMPUTING ANYWHERE
Cloud as a New Platform

BILLIONS of users 3rd PLATFORM
3rd PLATFORM
1,000s of applications

Cloud – mobile, browser, social, big data

HUNDREDS OF MILLIONS of users 2nd PLATFORM
2nd PLATFORM
10,000s of applications

PC - LAN, Internet

MILLIONS of users 1st PLATFORM
1st PLATFORM
1,000s of applications

Terminal - mainframe, mini

Source: IDC, 2013
MATLAB Mobile
Support for iPhone, iPad & Android
The cloud, enhancing your MATLAB Desktop
MATLAB Distributed Computing Server on Amazon EC2
The cloud, running MATLAB, on demand, from anywhere
The cloud, running MATLAB, on demand, from anywhere
Running in Enterprise IT Environments
MATLAB Production Server

- Deploy MATLAB analytics into enterprise IT frameworks
- Integrate with databases, webservers and application servers

Seamless transition from algorithm prototyping to enterprise-scale analytics without recoding

“This product is a game changer, for sure.”

Quantlabs
PEOPLE COMPUTING ANYWHERE

- MATLAB on mobile devices
- MATLAB on the cloud
Higher Education Is Now Ground Zero For Disruption
MOOCs

- Online course
- Unlimited participation
- Open access via the web

MOOC = Massive Online Open Course
Algorithms in everything

Connected chips, devices & systems

Hardware in specialized form factors

People computing anywhere