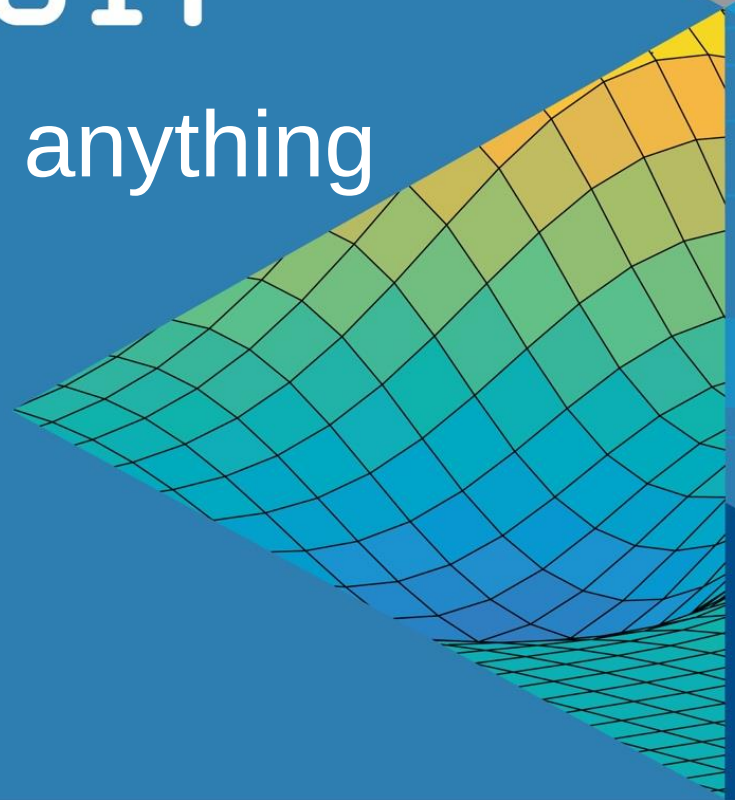
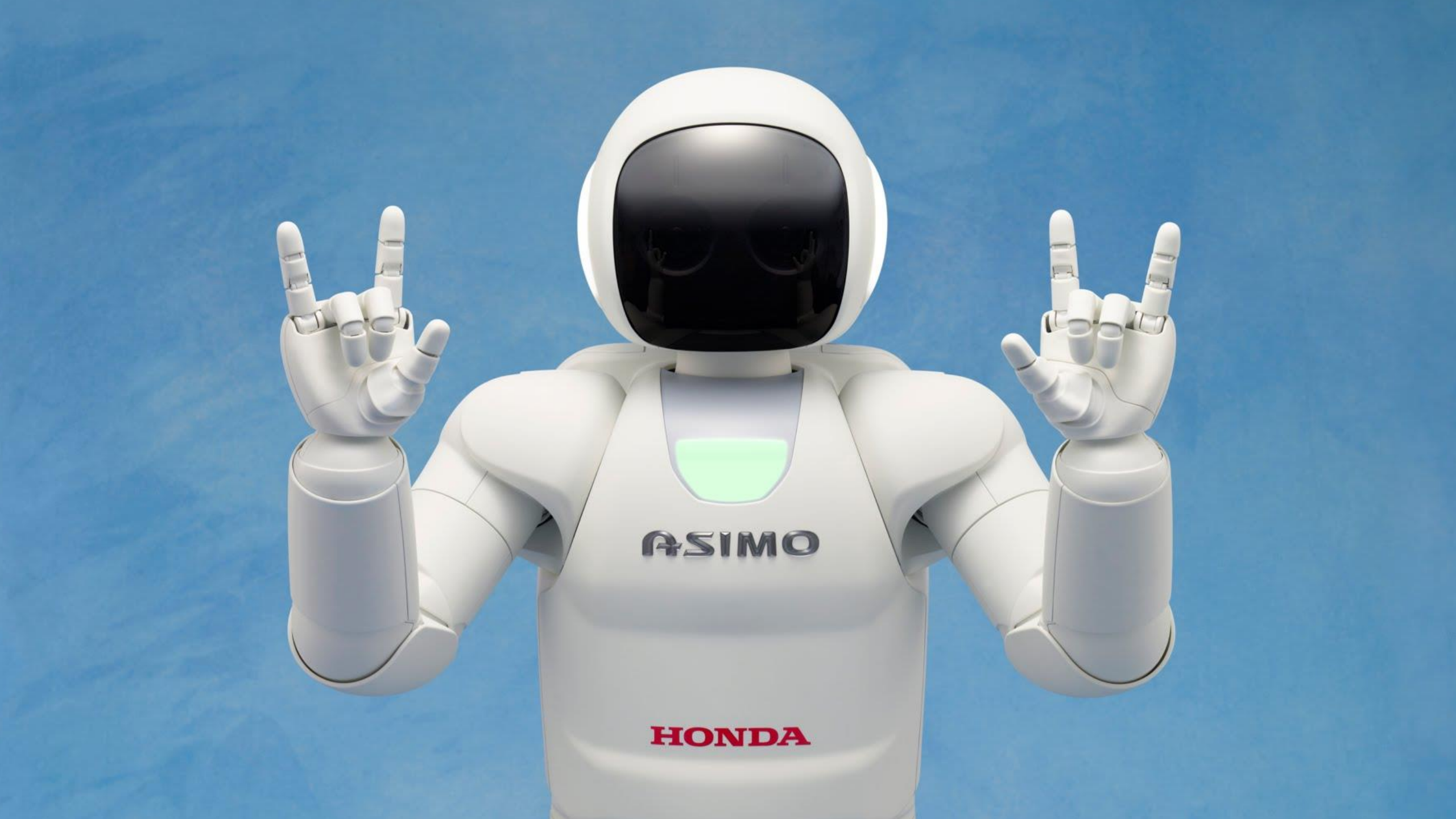
MATLAB EXPO 2017

How to build an **autonomous** anything

Jason Ghidella
Simulink Platform Marketing Manager
MathWorks




HYUNDAI
Autonomous
IONIQ


ASIMO
HONDA


amazon


5" 12,000 PSI
5" 12,000 PSI
BAKER HUGHES


127 mg/dl
189 mg/dl
97 mg/dl
Well, hello Sunshine. What's for breakfast?
CGM

Autonomous Technology

Autonomous Technology

Having the power for self-governance

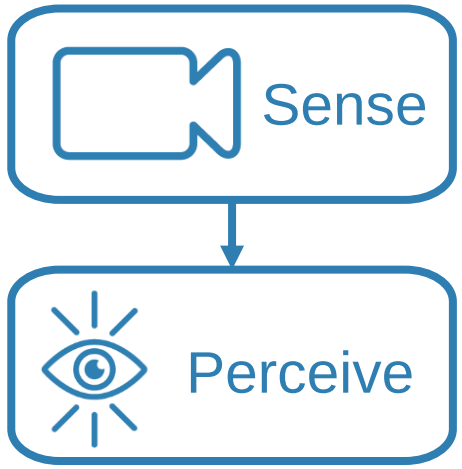
Autonomous Technology

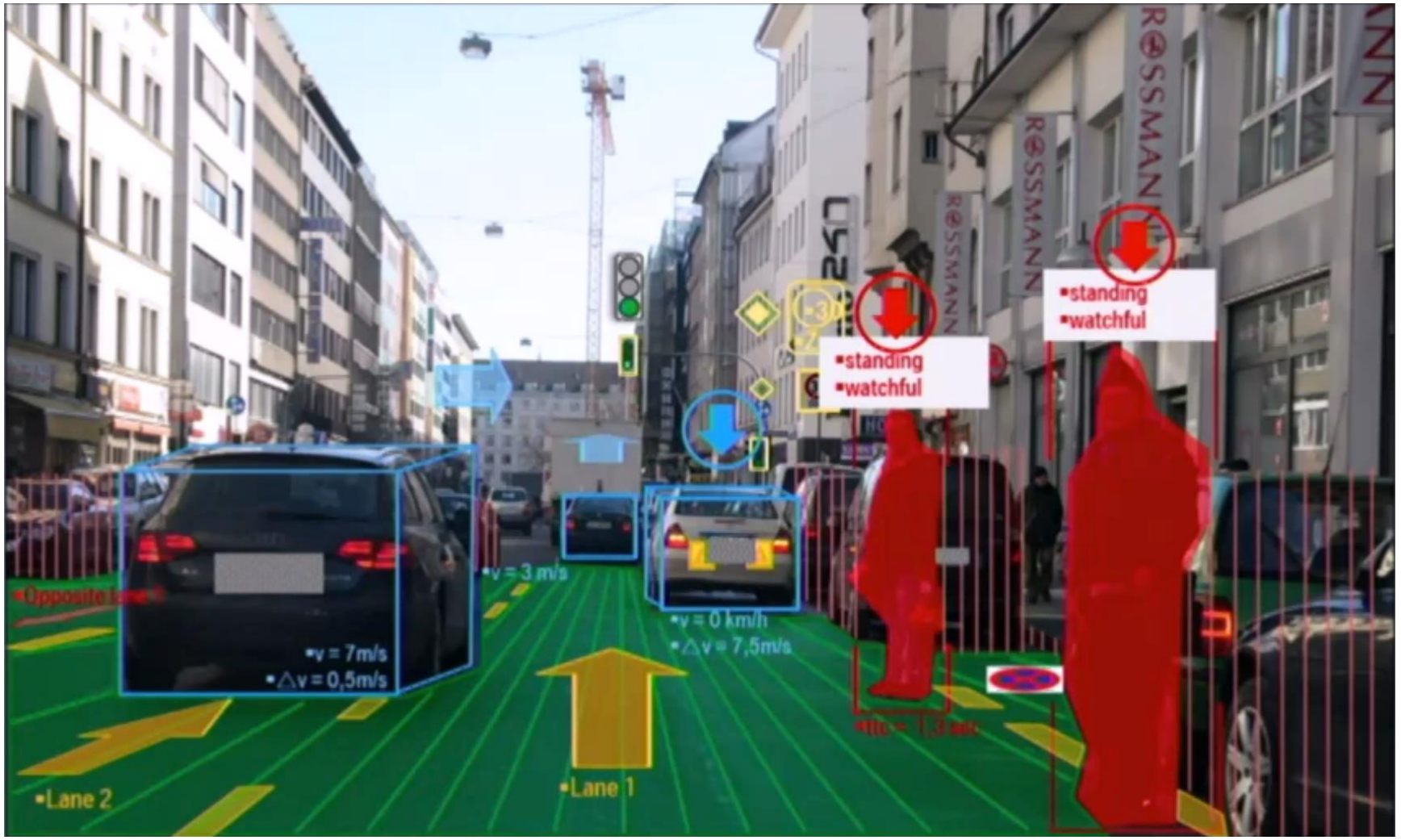
Provides the ability of a system to act independently of direct human control under unrehearsed conditions

Capabilities of an Autonomous System

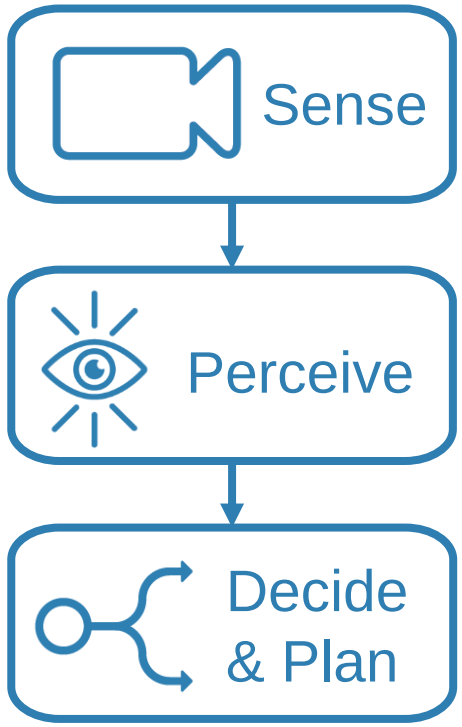
Sense

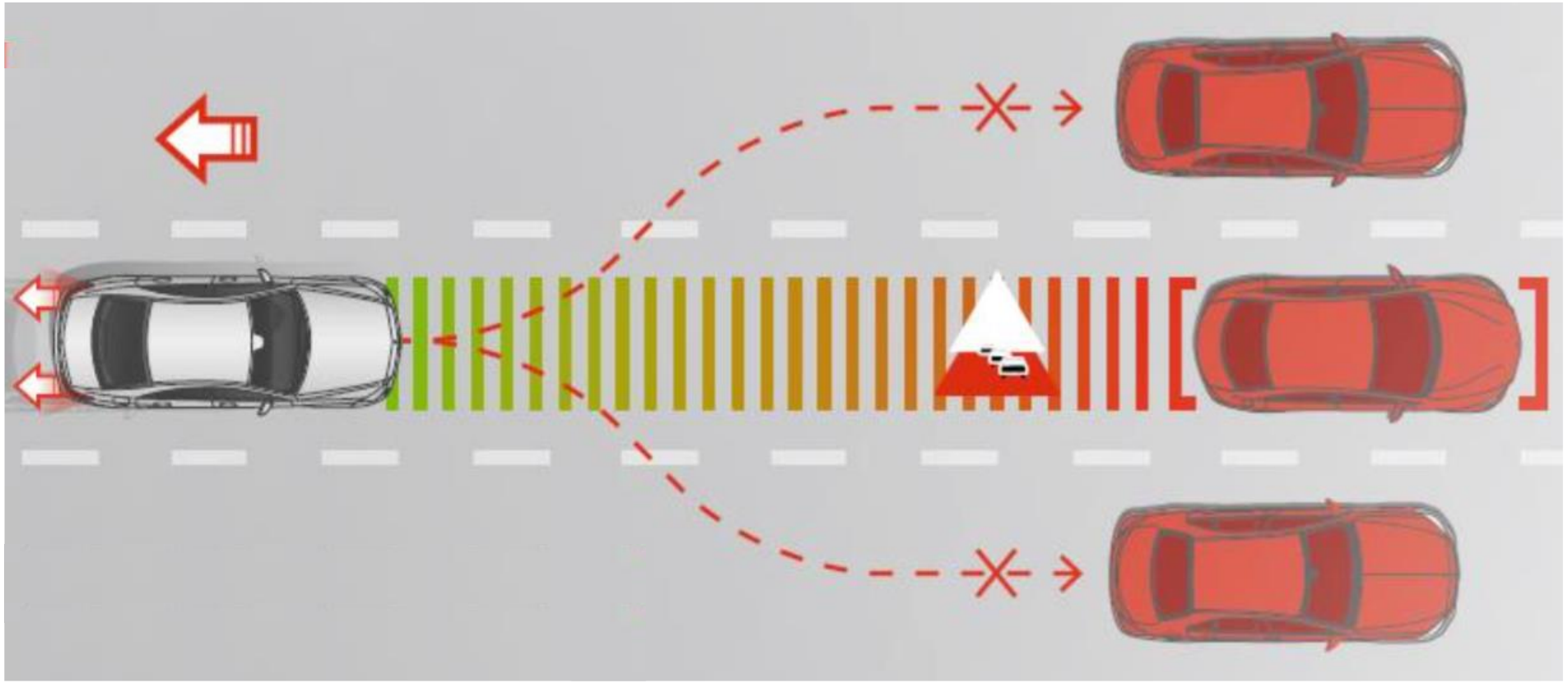
Capabilities of an Autonomous System



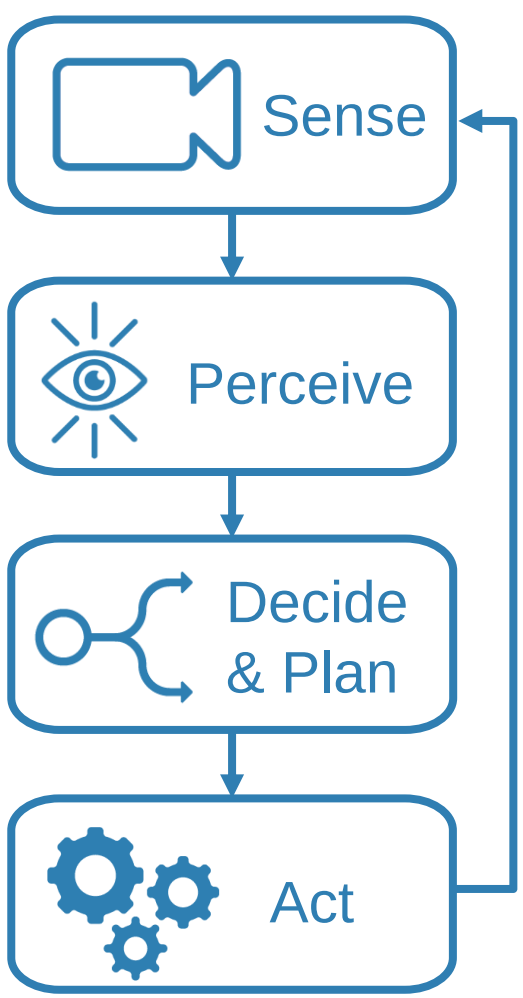


Capabilities of an Autonomous System

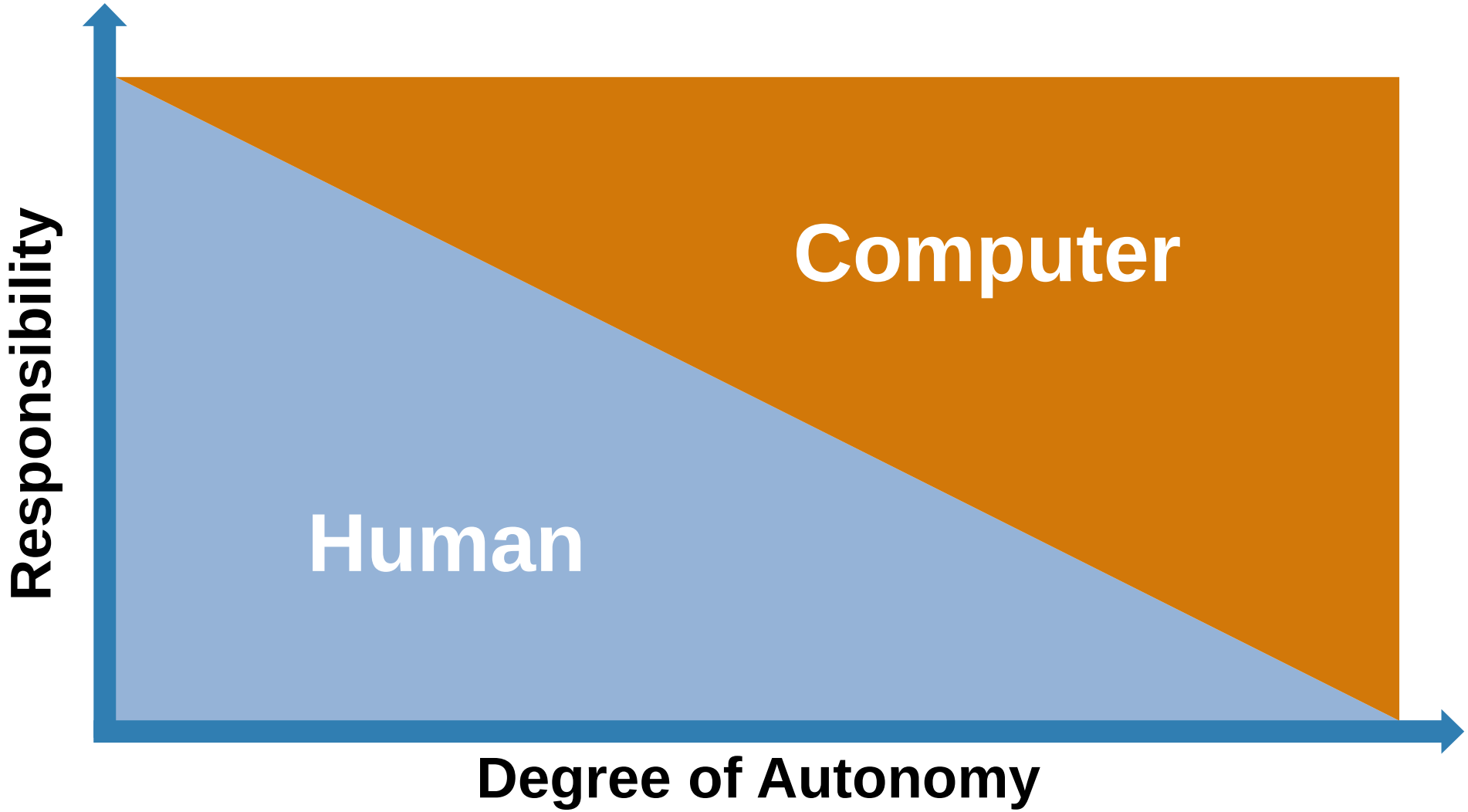


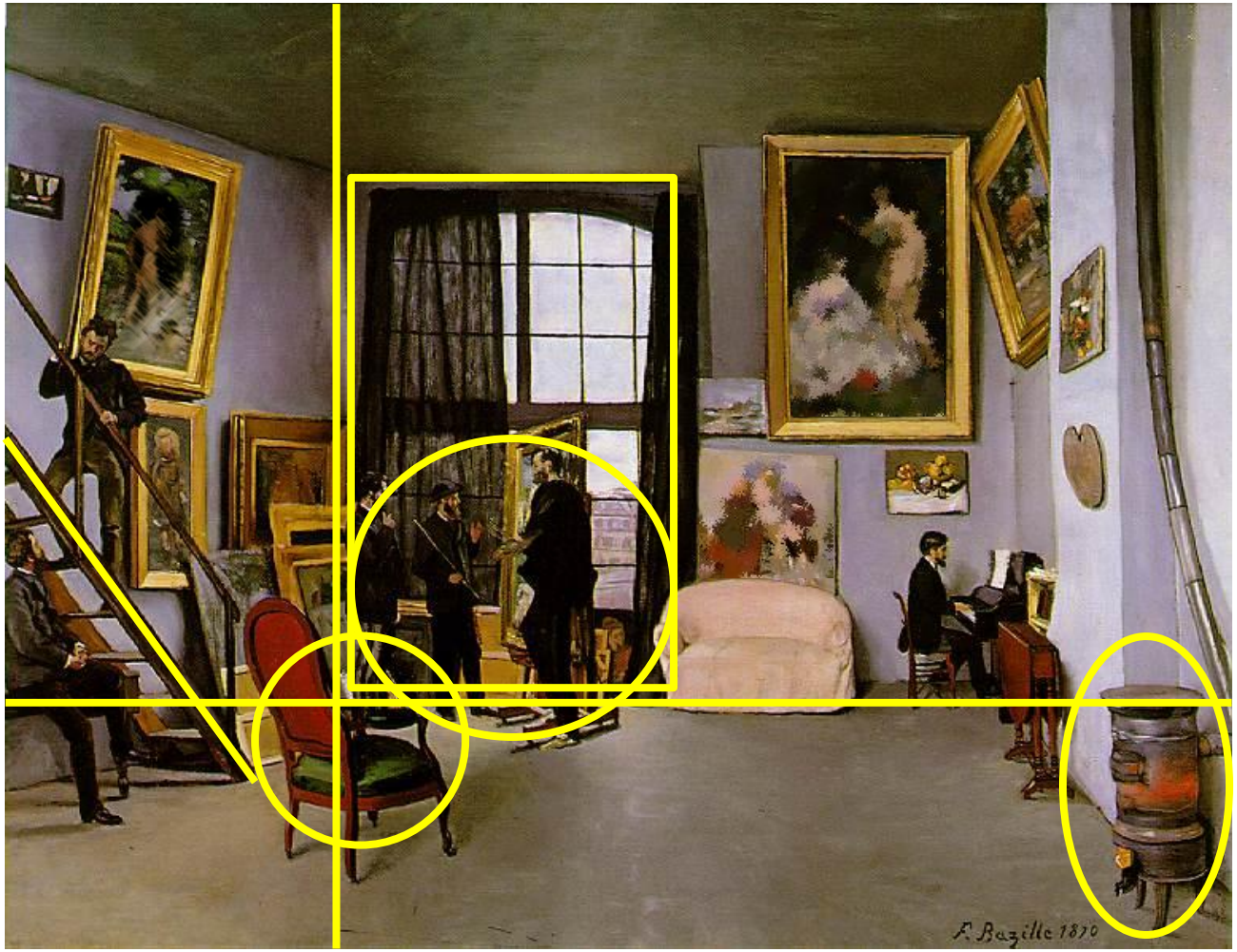


Capabilities of an Autonomous System



Autonomous Technology Transfers Responsibility to Computers





Bazille's Studio
Bazille 1870

Shuffleton's Barbershop
Rockwell 1950

Autonomous Artistic Style Classification
Rutgers University

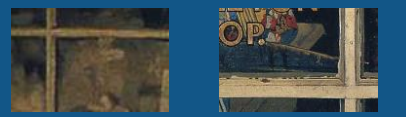
Sense

Perceive

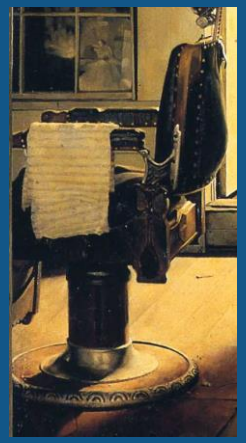
Decide & Plan

Act

Image Feature Extraction



Visual Features



Machine Learning Classification

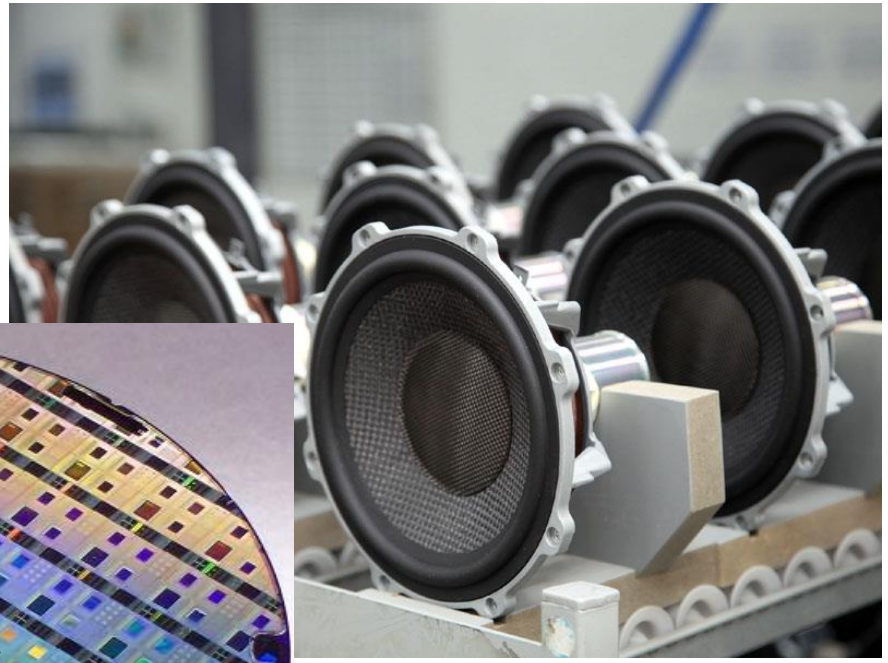
Style Classifier (SVM) → **Style:** Regionalism

Genre Classifier (SVM) → **Genre:** Interior

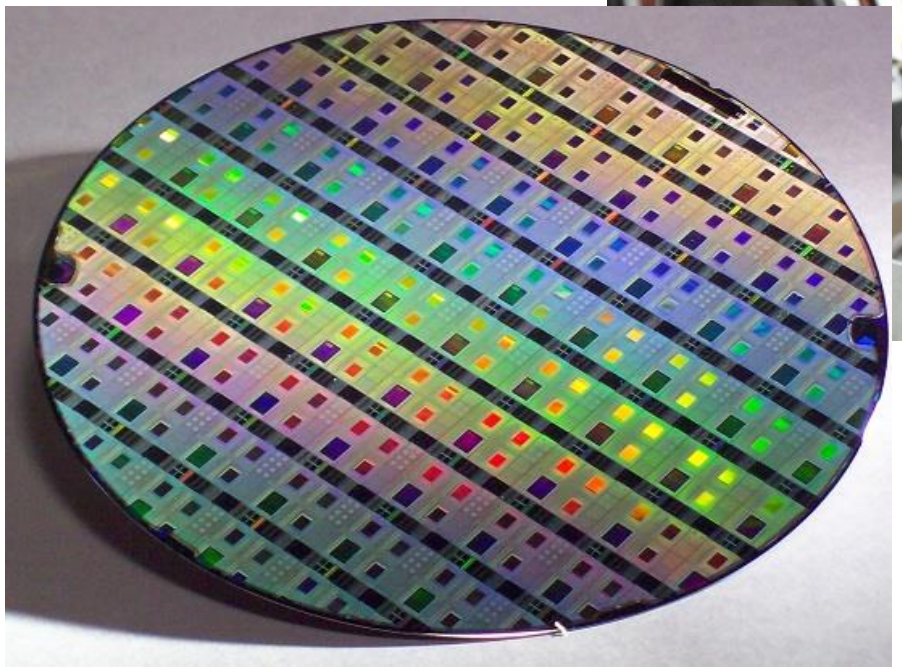
Artist Classifier (SVM) → **Artist:** Rockwell

Where to add autonomy with perception?

- Analyze more data
- Reduce bias
- Reduce variability
- Save time
- Improve performance



Determine Loudspeaker Quality



Virtual Semiconductor Manufacturing Calibration

Where to add autonomy with perception?

- Analyze more data
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- Reduce variability
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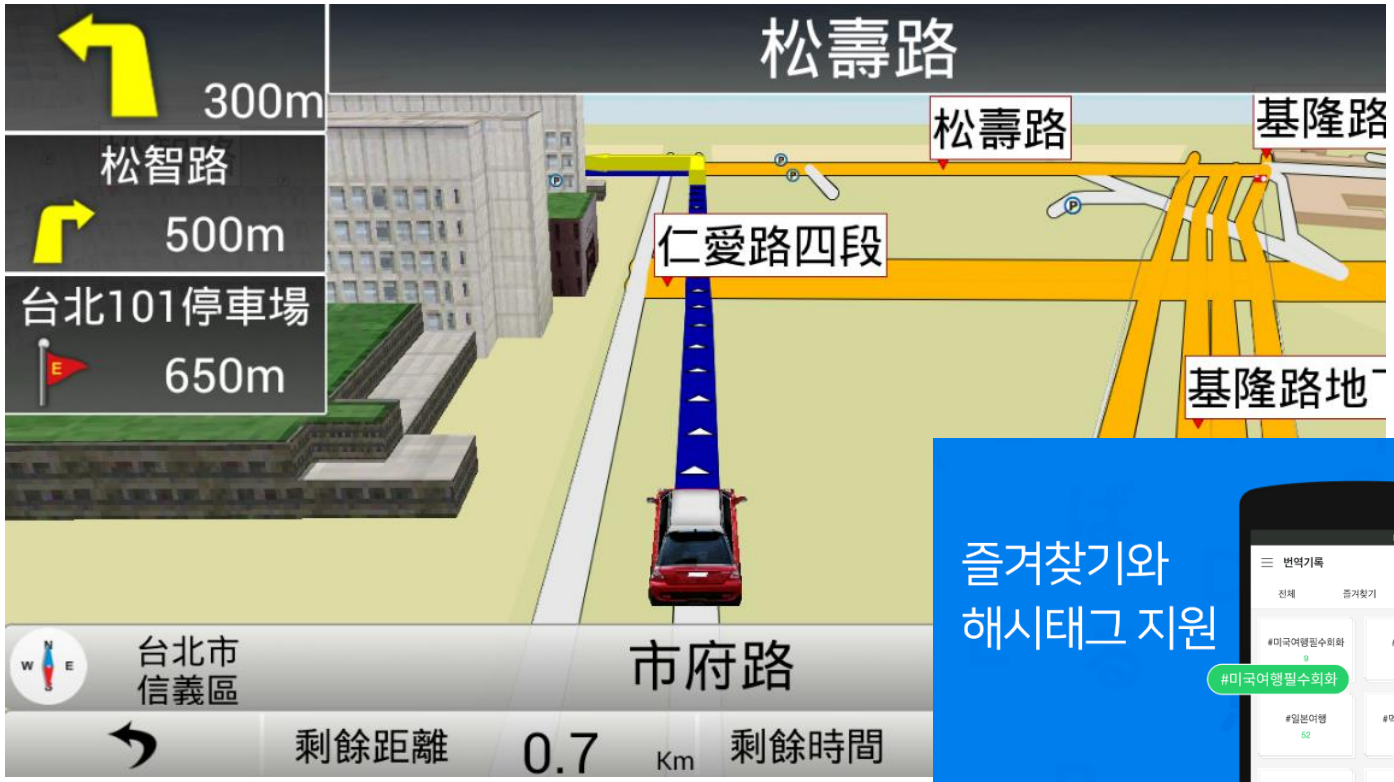
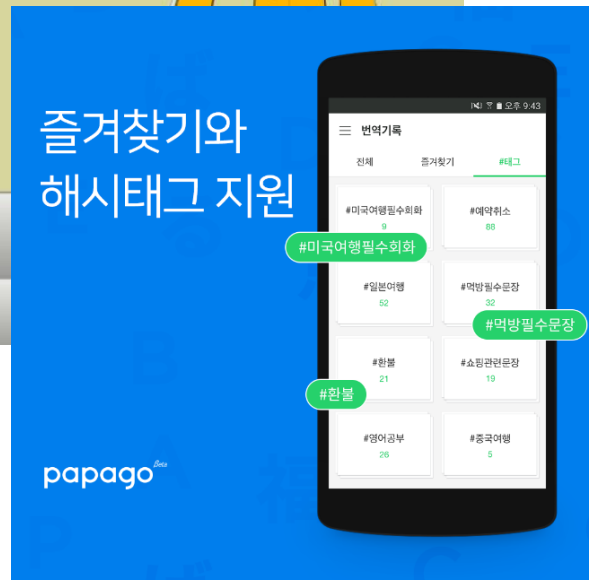
- Improve performance





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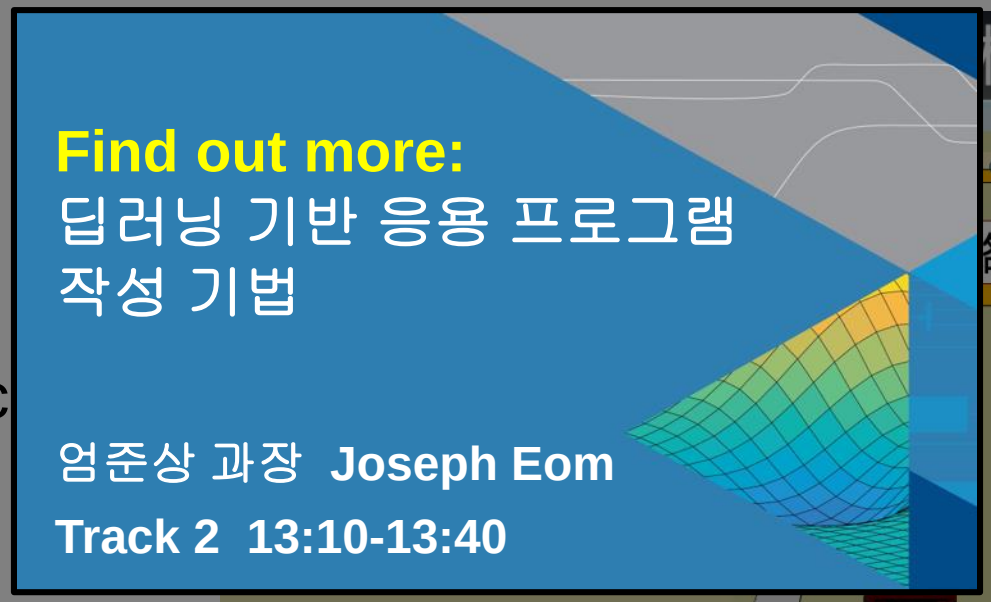



5" 12,000 PSI
5" 12,000 PSI
BAKER HUGHES

Autonomous Service for Predictive Maintenance

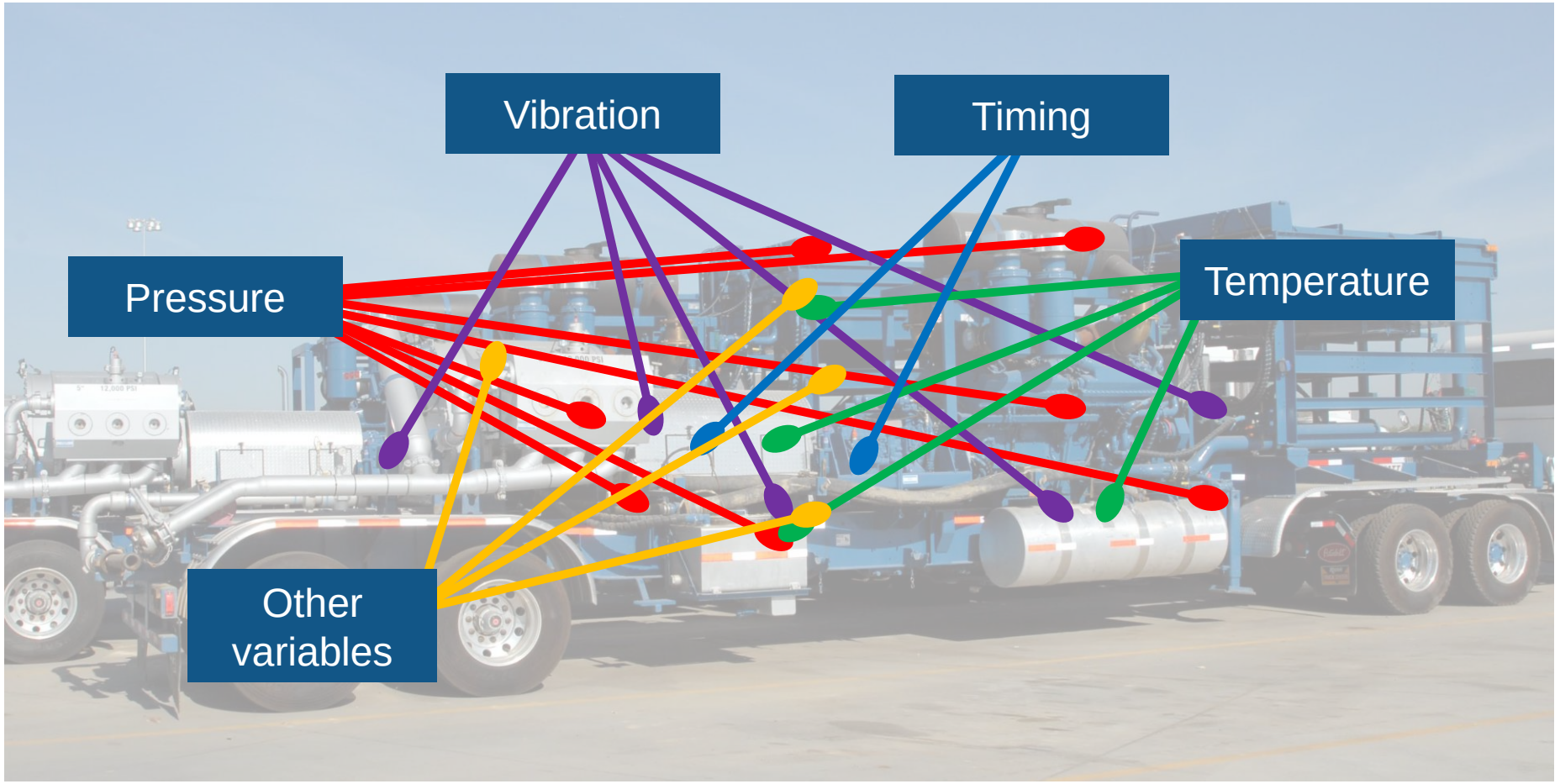
Sense

Perceive

Decide & Plan

Act

Which sensor values should they use?



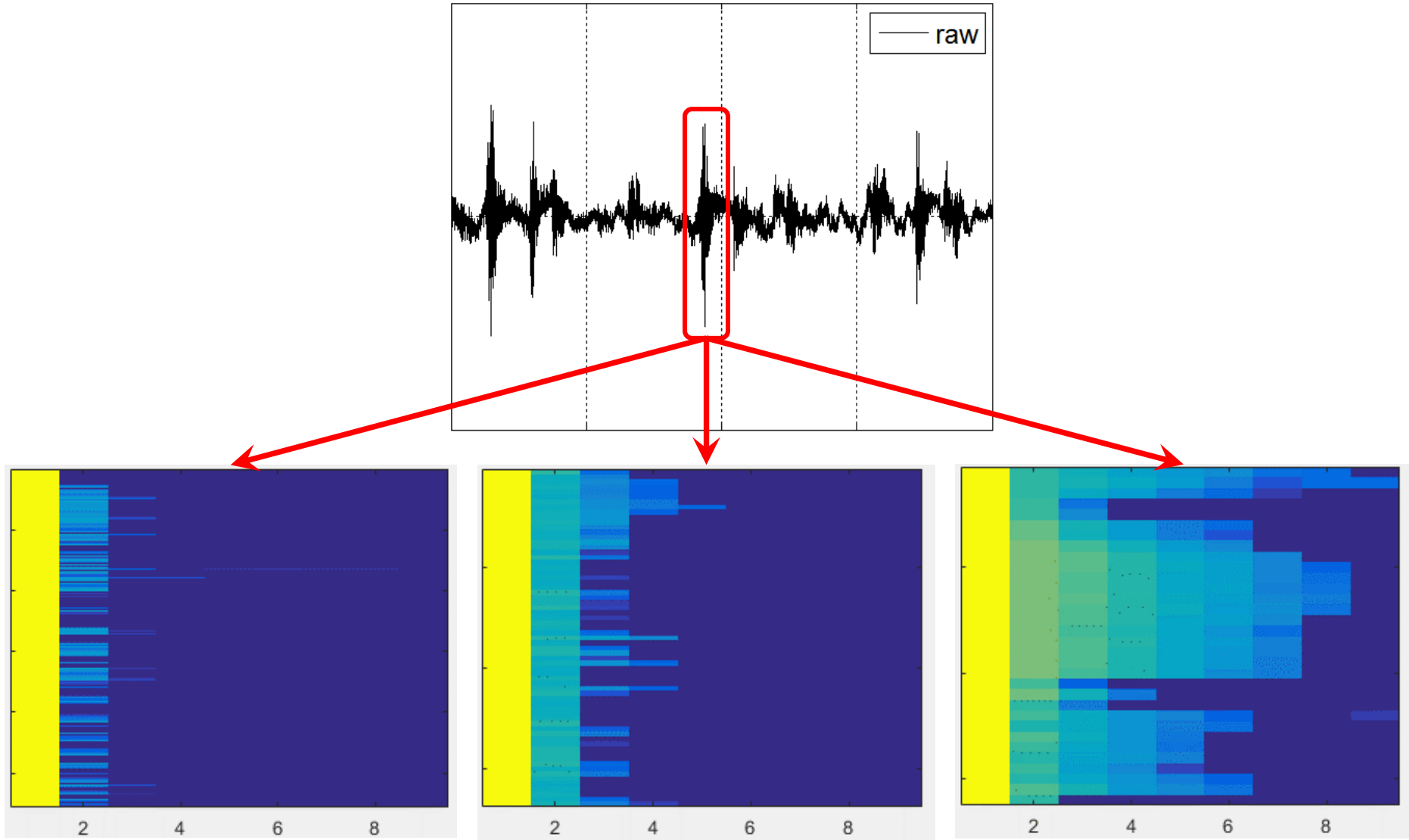
Autonomous Service for Predictive Maintenance

Sense

Perceive

Decide & Plan

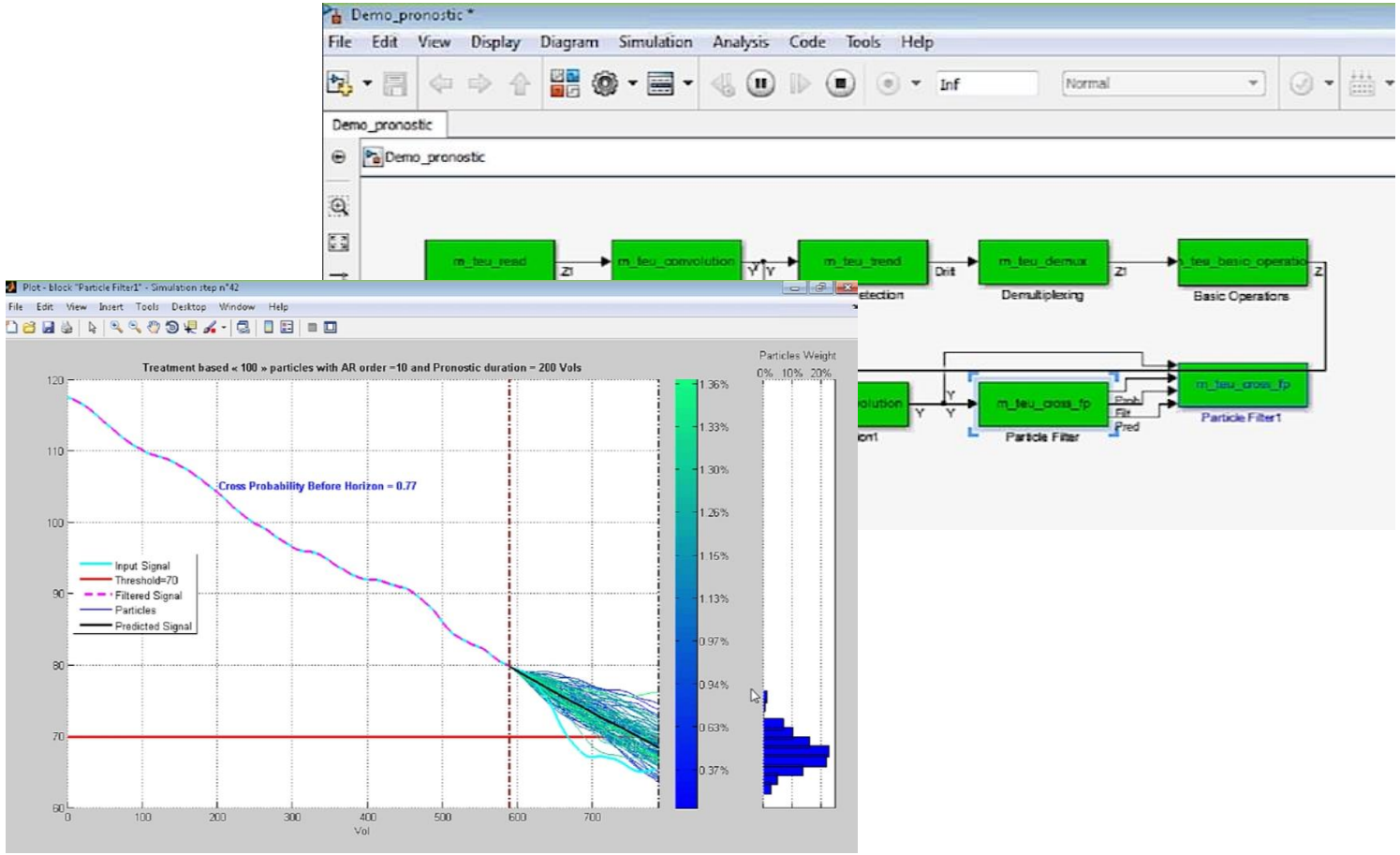
Act



Normal Operation | Monitor Closely | Maintenance Needed

What are the best predictors?

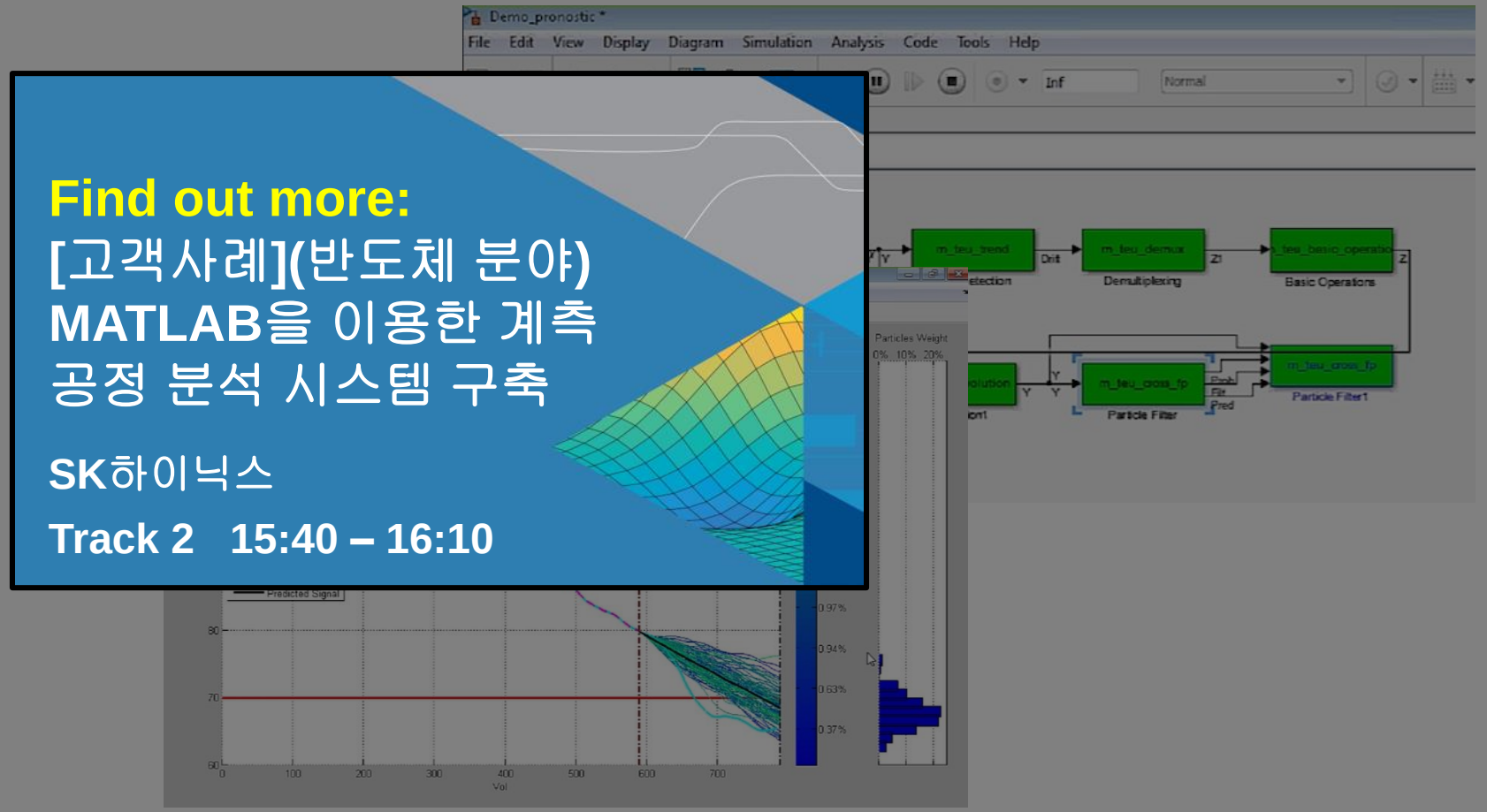
- Data
- Models



Jet Engine Monitoring

What are the best predictors?

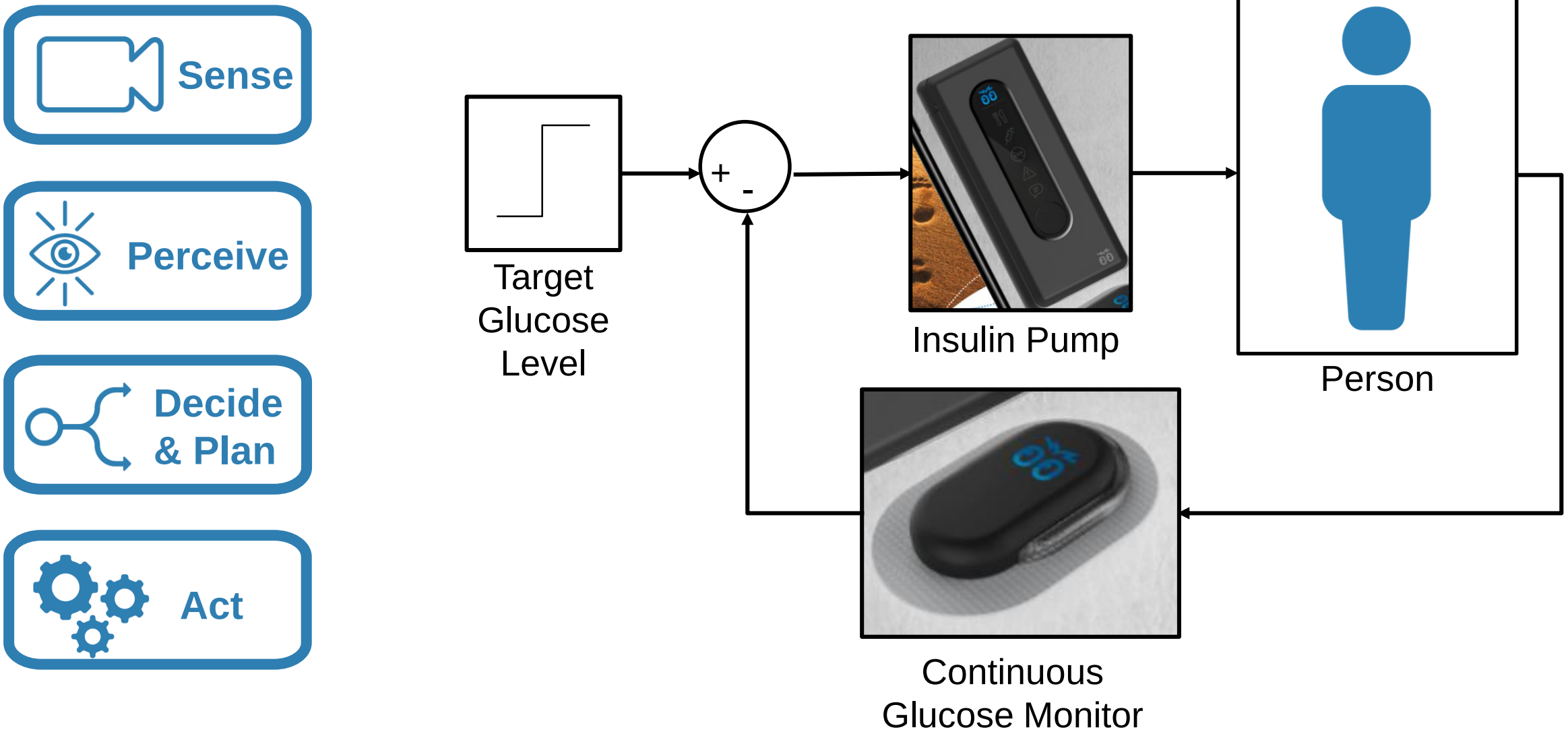
- Data
- Models



Jet Engine Monitoring

Autonomous Glucose Level Management

Autonomous Glucose Level Management
Bigfoot Biomedical



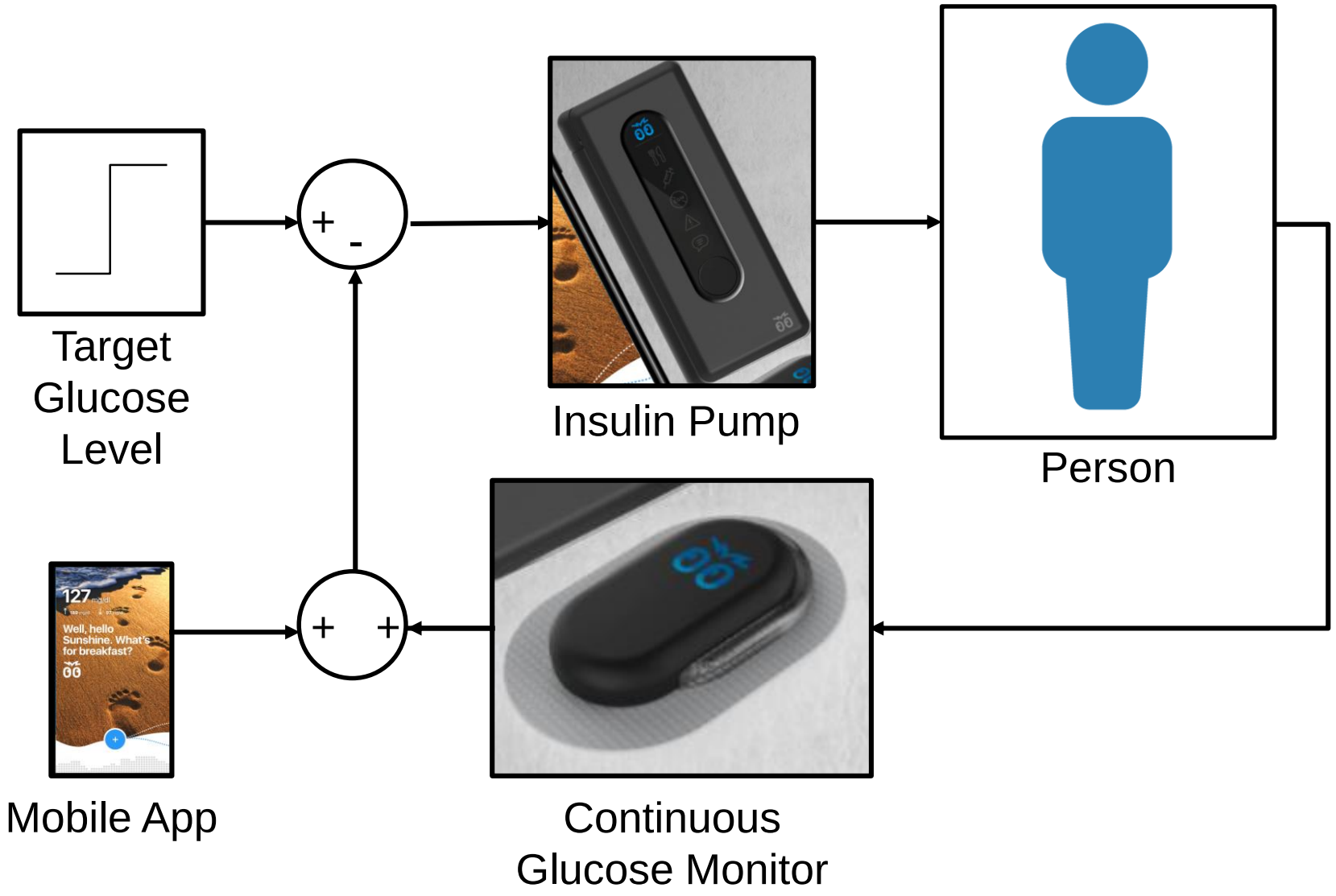
Autonomous Glucose Level Management
Bigfoot Biomedical

Sense

Perceive

Decide & Plan

Act



Autonomous Glucose Level Management
Bigfoot Biomedical

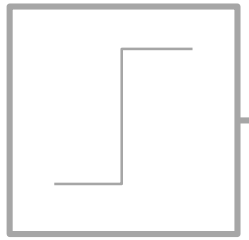
Virtual Lab
Simulink, Stateflow
Polyspace

Sense

Perceive

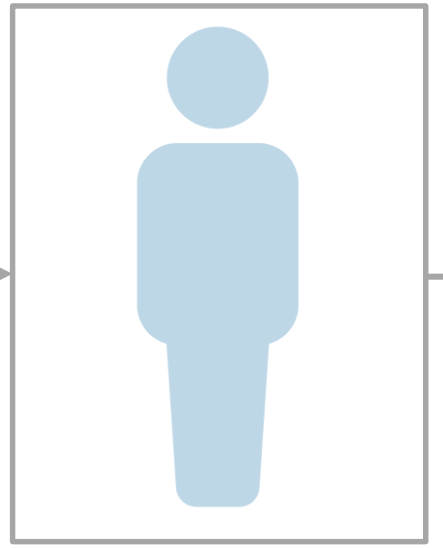
Decide & Plan

Act

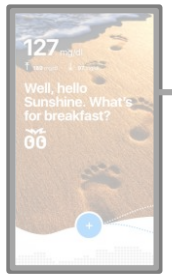


Target Glucose Level

Insulin Pump



Person



Mobile App

Continuous Glucose Monitor

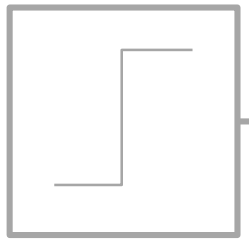
Autonomous Glucose Level Management
Bigfoot Biomedical

Sense

Perceive

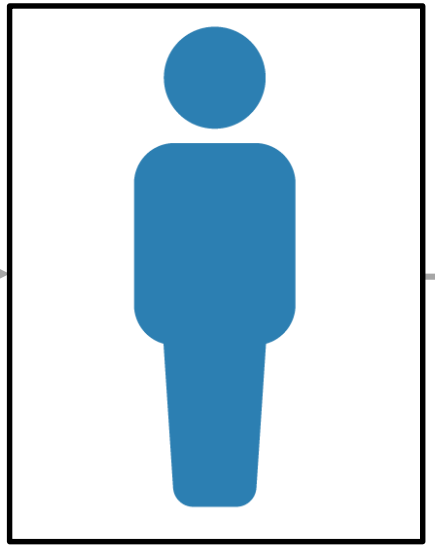
Decide & Plan

Act



Target Glucose Level

Insulin Pump



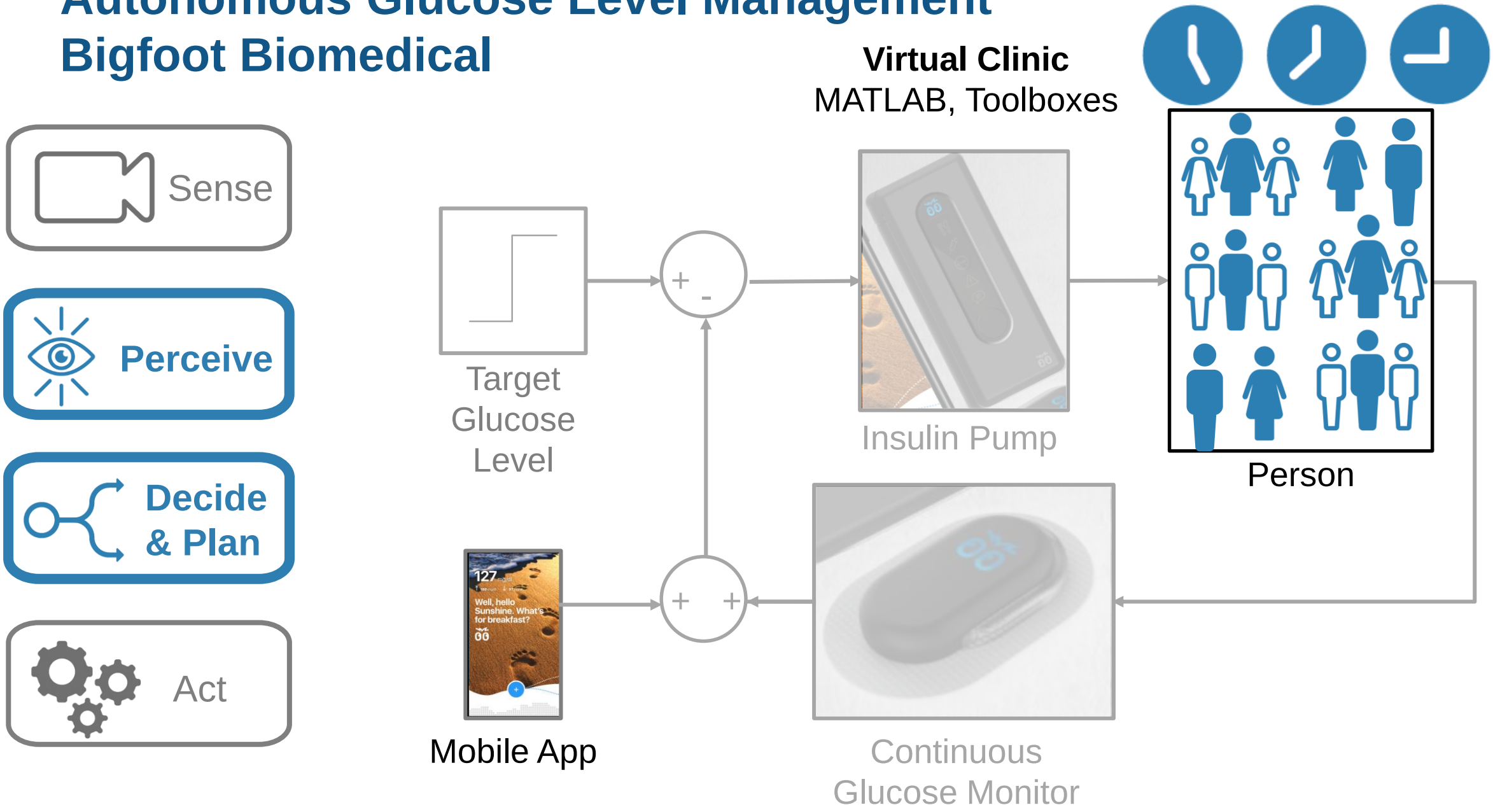
Person

Mobile App

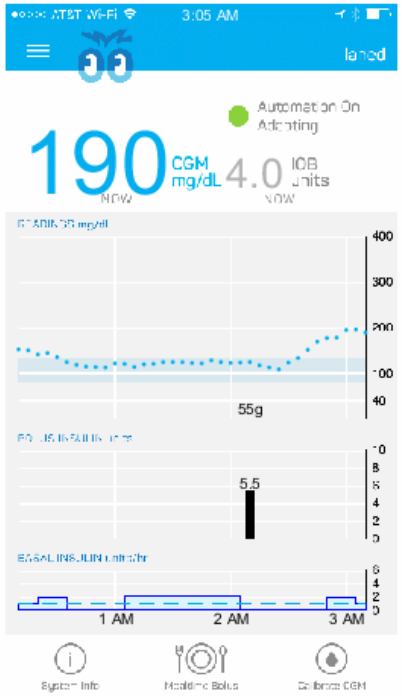
Continuous Glucose Monitor

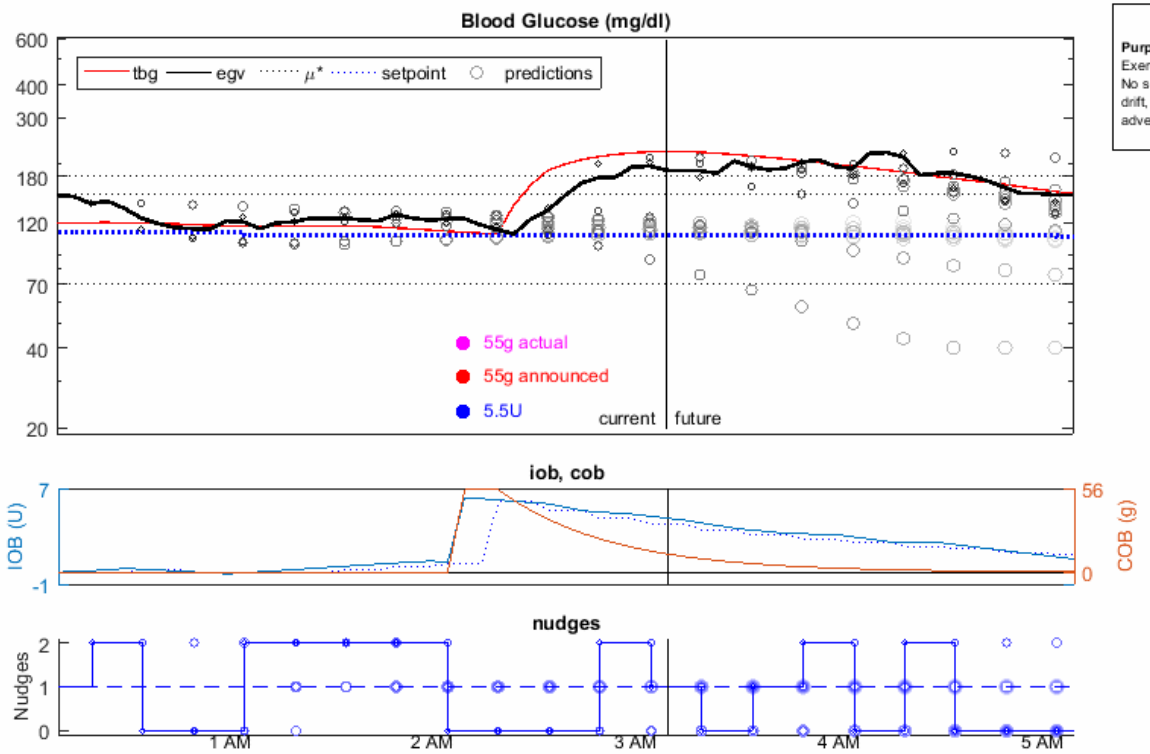
Autonomous Glucose Level Management
Bigfoot Biomedical

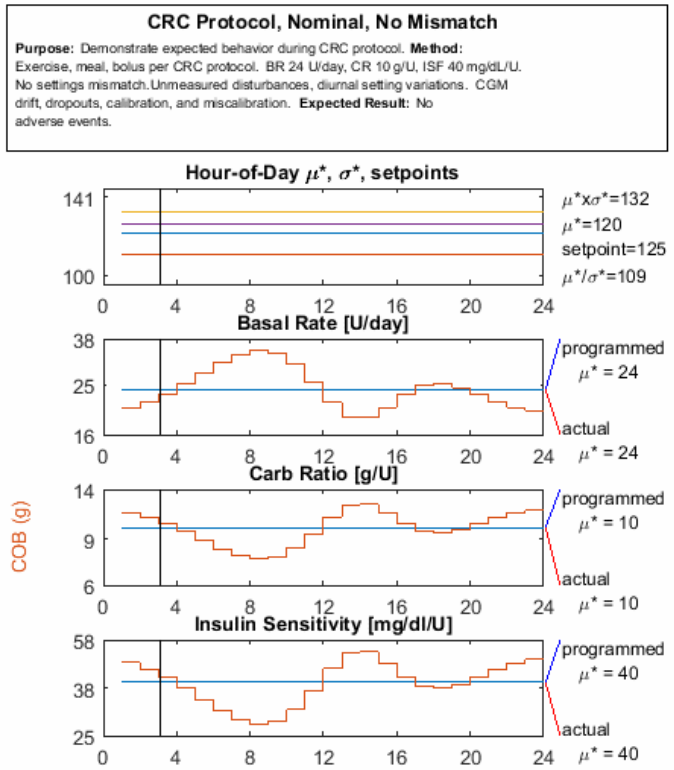
Virtual Clinic
MATLAB, Toolboxes

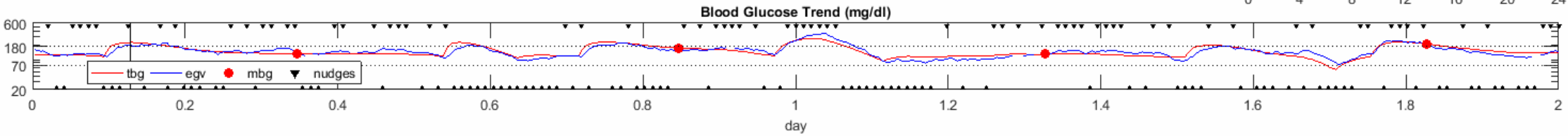


Virtual Clinic
Generating data through simulation

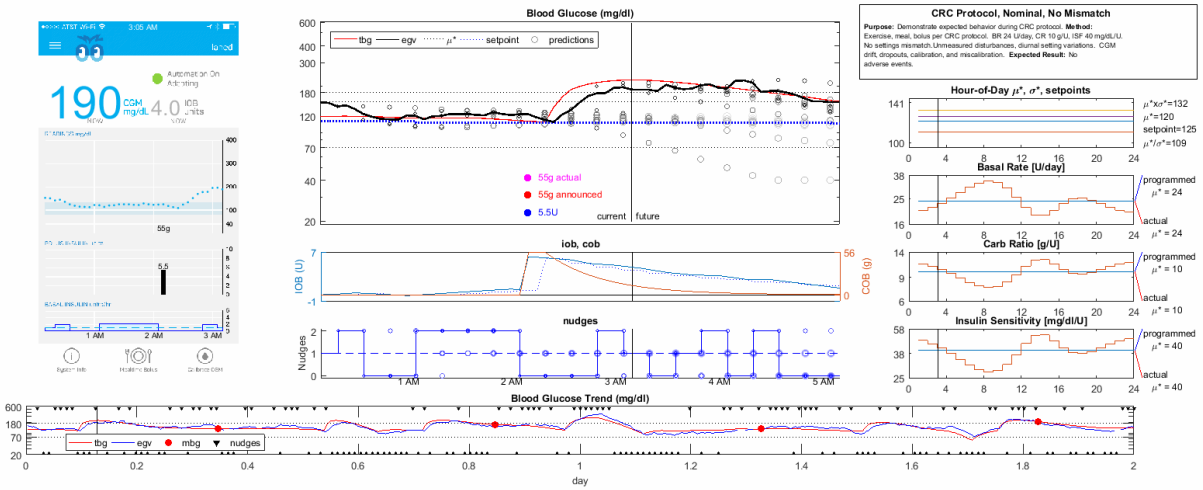








Virtual Clinic
Scaling computations to simulate 50 million patients a day



Where will you get your data?

- Simulation
- Public repositories
- In the lab
- In the field
- Internet of Things (IoT)

Where will you get your data?

- Simulation
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- In the field
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Autonomous Trailer Filling

Sense

Perceive

Decide & Plan

Act

Autonomous Trailer Filling

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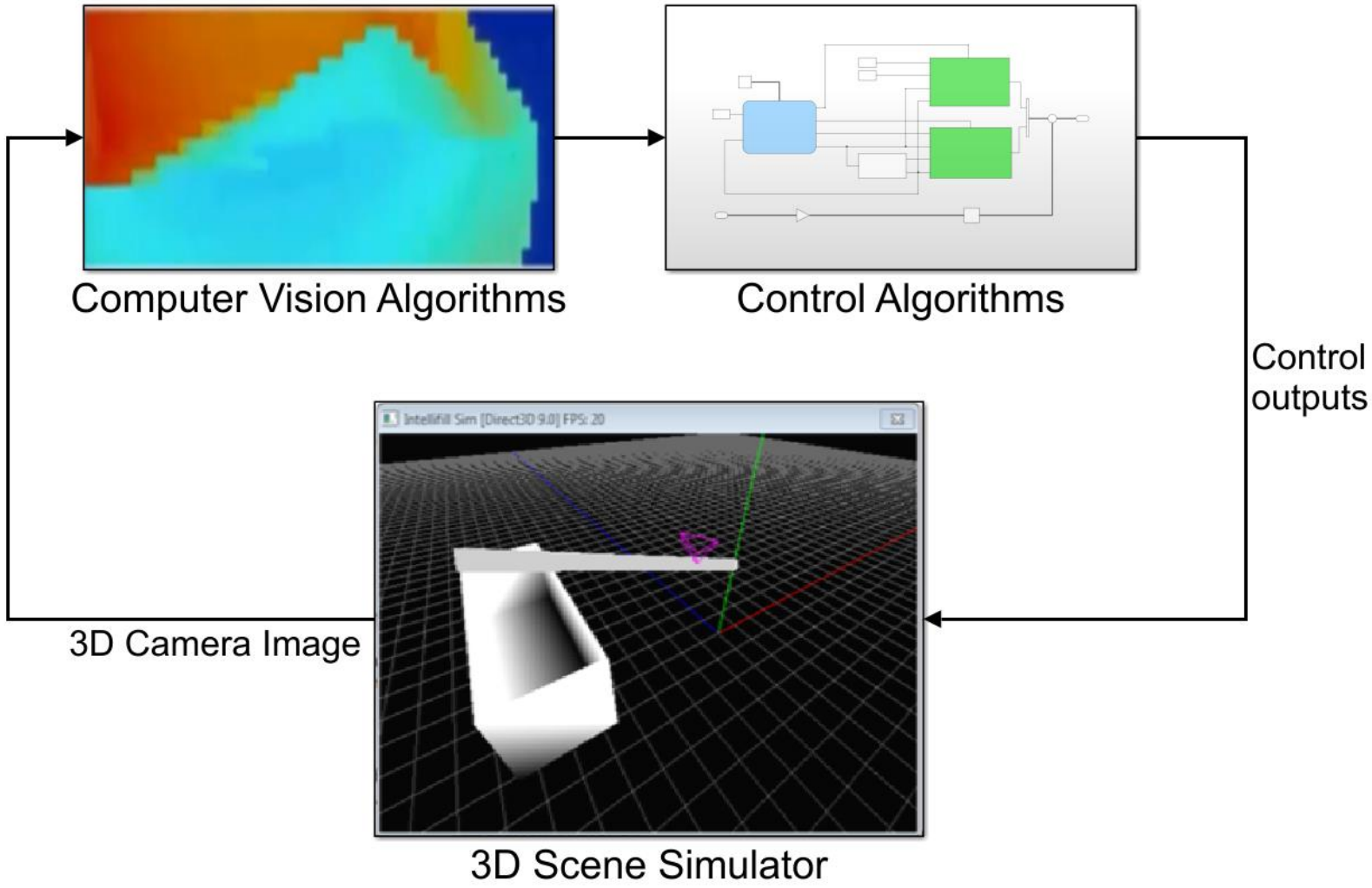

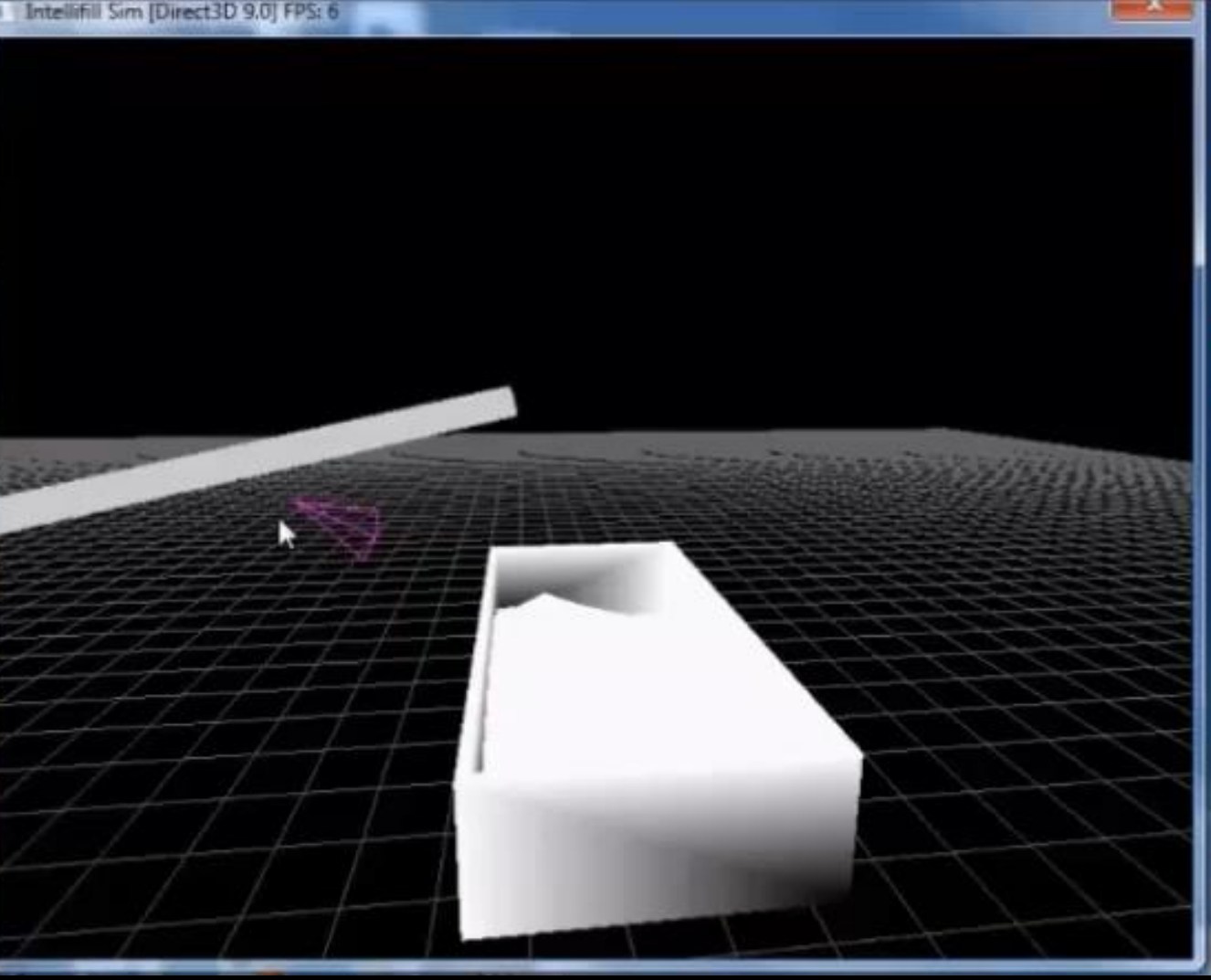
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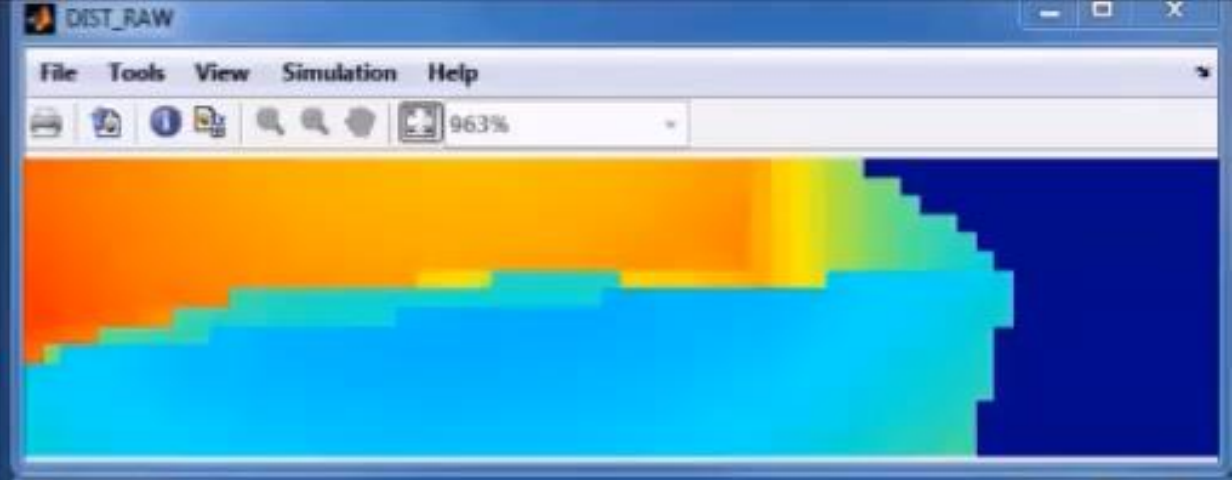
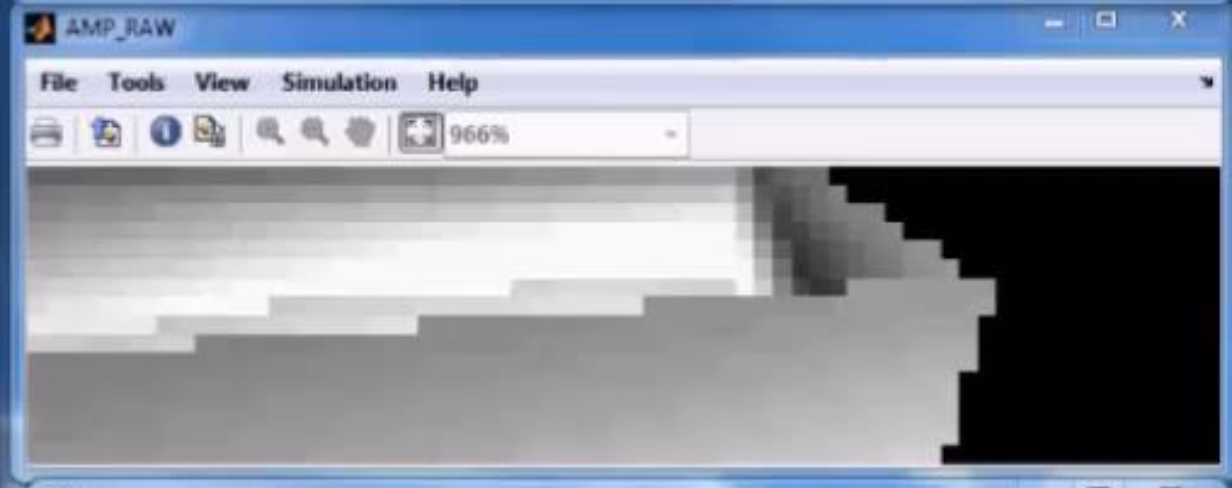

DIST_RAW
File Tools View Simulation Help
963%


AMP_RAW
File Tools View Simulation Help
966%


Overlay_Dist_image
File Tools View Simulation Help
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0133
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RW
CCW
0279

Autonomous Trailer Filling

Sense

Perceive

Decide & Plan

Act

3D Camera

Embedded Platform
MPC5121e

- User Input
- Visualization

CAN

Actuators

ECU

Computer vision and controls algorithms

Autonomous Trailer Filling

Sense

Perceive

Decide & Plan

Act

Embedded Platform MPC5121e

3D Camera

- User Input
- Visualization
- Computer Vision
- Controls

Embedded Coder

CAN

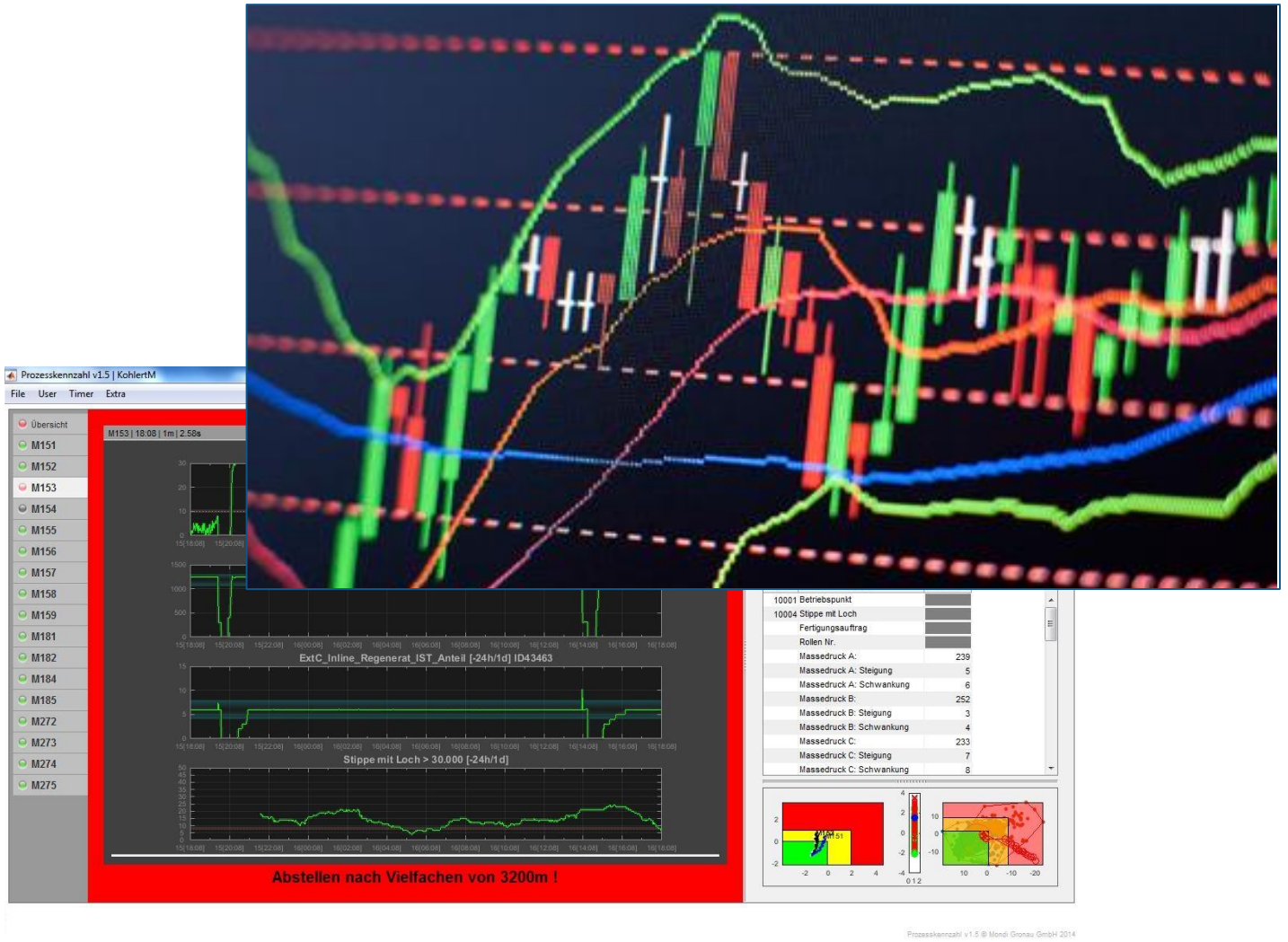
Actuators

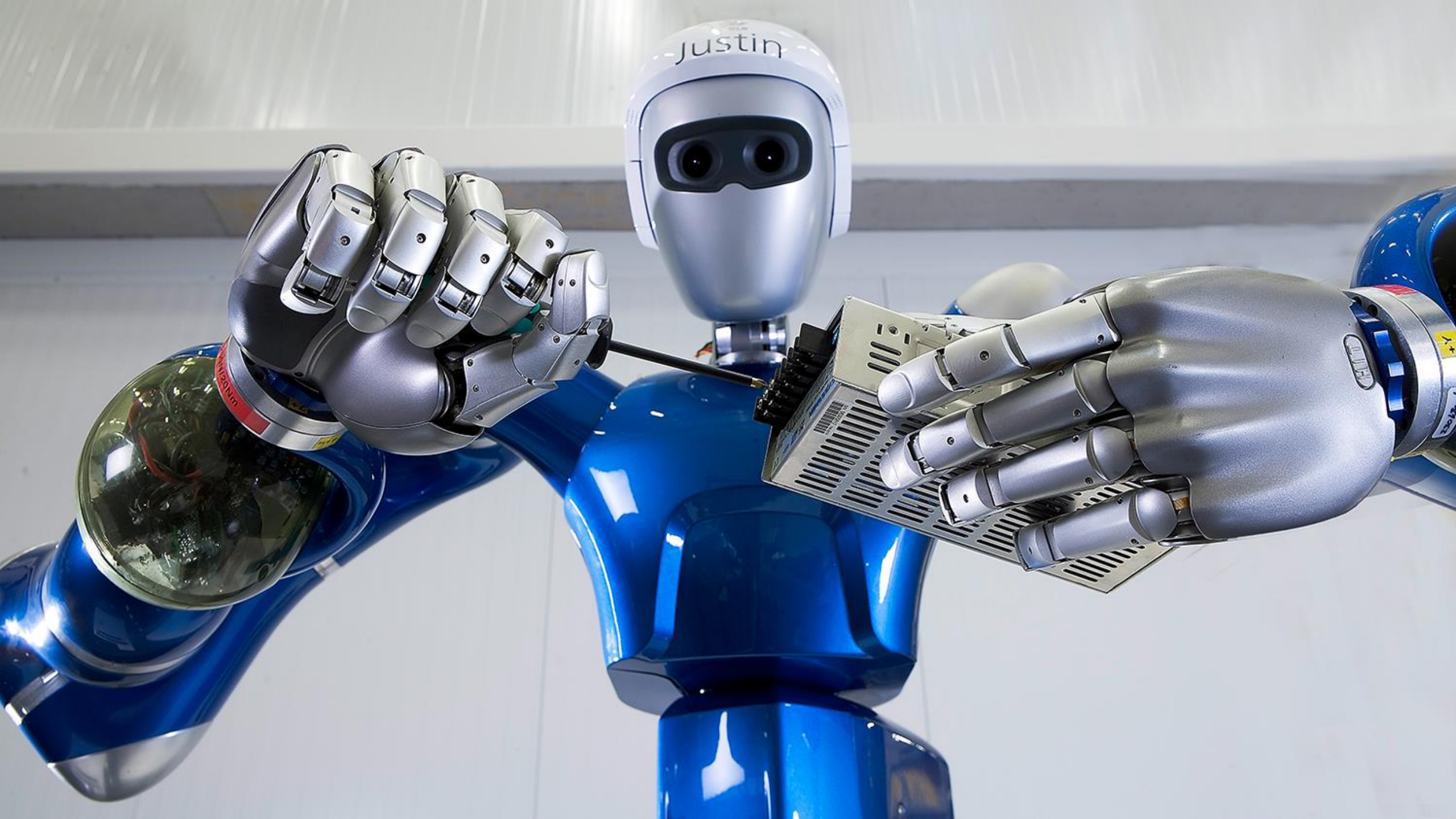
ECU

Monitoring

How will you put it into production?

- Embedded Systems
- IT Systems
- Desktop Apps




Justin

How to build an autonomous anything

Focus on Perception	• Look for autonomy in creative places • Do more than manually possible
Use the Best Predictors	• Data-driven • Model-driven
Get the Right Data	• Reduce to actionable data • Take advantage of Big Data • Use simulation to supplement available data
Flow to Production	• Address the architecture • Leverage Model-Based Design for embedded • Automate integration with enterprise IT systems

What is ***your***
autonomous anything?

MATLAB Expo 2017

시간	일정				
09:40-09:50 (10)	환영사 매스웍스코리아 이종민 대표이사				
09:50-10:20 (30)	고객 기조연설 : 제4차 산업혁명과 MATLAB을 통한 대학교육의 혁신 수원대학교 이남식 제2창학 위원장				
10:20-10:50 (30)	MathWorks 기조연설 : How to Build an Autonomous Anything Jason Ghidella 이사				
10:50-11:20 (30)	R2016b와 R2017a를 중심으로한 새로운 기능 이영준 부장				
11:20-11:40 (20)	휴식 및 부스관람				
	Track 1	**Track 2**	**Track 3**	**Subtrack 1**	**Subtrack 2**
	신호처리, 컴퓨터비전 그리고 무선 기술	엔지니어링 데이터분석 및 애널리틱스 솔루션	모델 기반 설계를 통한 임베디드 시스템 개발	Tech Talk Special 1	Tech Talk Special 2
11:40-12:10 (30)	컴퓨터 비전의 최신 기술 (Deep Learning, 3D Vision, Embedded Vision)	빅데이터 처리 및 머신 러닝 기법	다중 센서 기반 자율 시스템의 모델 기반 설계 및 개발		
	김종남 차장	엄준상 과장	이제훈 차장		
12:10-13:10 (60)	Lunch				
13:10-13:40 (30)	위상 배열 레이더를 위한 시스템 설계	딥러닝 기반 응용 프로그램 작성 기법	[고객사례]Active Seat Belt 제어로직을 이용한 AEB 제동시나리오 승객거동해석	Simscape Power Systems를 이용한 전력전자 설계 및 시뮬레이션	MATLAB 라이브 에디터 소개
	Rick Gentile	엄준상 과장	현대모비스	강효석 과장	송완빈 대리
13:40-13:50 (10)					
13:50-14:20 (30)	[고객사례]신호분석시스템 개발 사례	엔터프라이즈 시스템에서의 빅데이터 애널리틱 애플리케이션 구축을 위한 MATLAB 기능	Simscape를 이용한 메케니컬 설계 와 멀티도메인 시뮬레이션 통합	Polyspace 제품군을 활용한 MISRA C:2012 가이드라인 및 실행시간 오류 검사	Simulink를 이용한 손쉬운 AUTOSAR 코드 구현
	LIG넥스원	성호현 차장	강효석 과장	유용출 과장	김종헌 부장
14:20-14:30 (10)					
14:30-15:00 (30)	신호처리 어플리케이션을 위한 전처리 설계 및 특징 추출 방법	Internet of Things(IoT) 를 위한 애널리틱 개발 및 적용	고 신뢰성 시스템을 위한 모델 기반 설계에서의 검증	Automated Driving 툴박스 소개	비디오 프로세싱 서브시스템의 설계 및 하드웨어 타겟팅 기법
	Rick Gentile	성호현 차장	이영준 부장	이제훈 차장	정승혁 과장
15:00-15:40 (40)	휴식 및 부스관람				
15:40-16:10 (30)	5G 무선통신 시스템 설계	[고객사례](반도체 분야) MATLAB을 이용한 계측 공정 분석 시스템 구축	Simulink와 Embedded Coder를 이용한 최적 코드 생성		
	김종남 차장	SK하이닉스	김종헌 부장		
16:10-16:20 (10)					
16:20-16:50 (30)	[고객사례]통계 및 기계학습을 이용한 생체물리정보 기반 퇴행성 신경계 질환 예측	MATLAB 과 Simulink 기반 병렬 컴퓨팅 기법	[고객사례]모델 기반설계 및 AUTOSAR 적용한 BMS 솔루션 개발		
	(주)제이어스 전진홍 박사	정승혁 과장	LG화학 조원태 부장		
16:50-17:00 (10)	경품 추첨				