

# NEXT GENERATION INTERNET – ROBOTICIST PERSPECTIVE

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Krzysztof Walas<sup>1</sup>

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<sup>1</sup>Institute of Control and Information Engineering, Faculty of Electrical Engineering,  
Poznan University of Technology

# OUTLINE:

Introduction

Industry 4.0

Latest Robotic Research Topics

Conclusions

# INTRODUCTION

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Assistant professor at Poznan University of Technology:

- multi-sensor perception for walking robots – recognizing terrain and its properties
- perception in elastic objects manipulation – tactile-vision fusion

Organizational Activities:

- “3rd Workshop on Recovering 6D Object Pose” – International Conference on Computer Vision 2017
- national coordinator of euRobotics week
- member of two topic groups in euRobotics
- member of industry transformation group (Ministry of Development)

# INDUSTRY 4.0

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Industry 4.0 is the next phase in the digitization of the manufacturing sector, driven by four disruptions<sup>1</sup>:

- spectacular rise in data volumes, computational power, and connectivity
- emergence of analytics and business-intelligence capabilities
- new forms of human-machine interaction such as touch interfaces and augmented-reality systems
- improvements in transferring digital instructions to the physical world, such as advanced robotics and 3-D printing

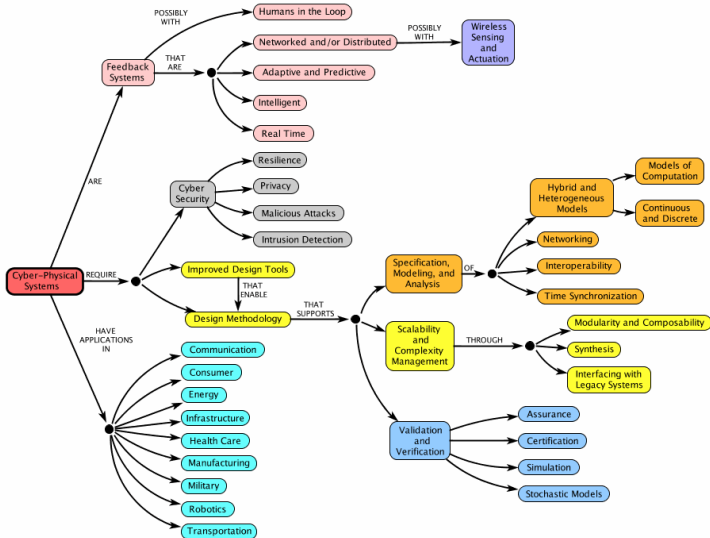
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<sup>1</sup>Source: <http://www.mckinsey.com/business-functions/operations/our-insights/manufacturings-next-act>

- Cyber-Physical Systems
- Internet of Things
- Intelligent Factory (cloud computing)

# CYBER-PHYSICAL SYSTEMS

<http://CyberPhysicalSystems.org>

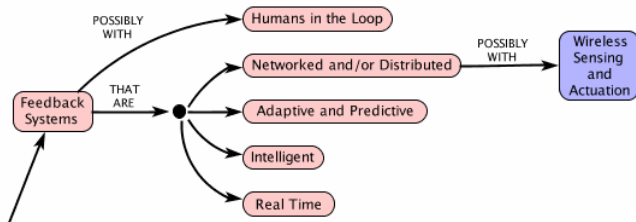


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<sup>2</sup>Source: <http://cyberphysicalsystems.org/>



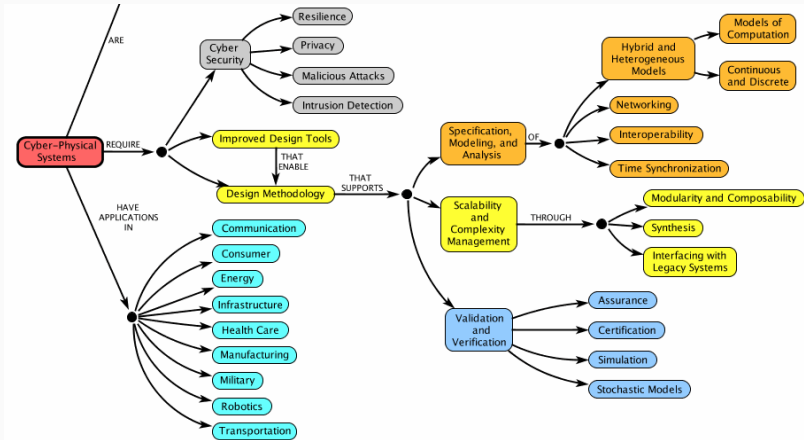
<http://CyberPhysicalSystems.org>



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<sup>3</sup>Source: <http://cyberphysicalsystems.org/>

# CYBER-PHYSICAL SYSTEMS



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<sup>3</sup>Source: <http://cyberphysicalsystems.org/>



- Cyber-Physical Systems – is a system of collaborating computational elements controlling physical entities. It is when the mechanical and electrical systems (e.g., sensors and communication tools) embedded in products and materials are networked using software components. They use shared knowledge and information from processes to independently control logistics and production systems.<sup>5</sup>
- Internet of Things – starts from the level where a single “thing” is identified using a unique global identifier and can be accessed from anywhere, anytime. The level of information obtained by accessing the “thing” can be as low as a static data that is stored on the RFID tags.<sup>5</sup>

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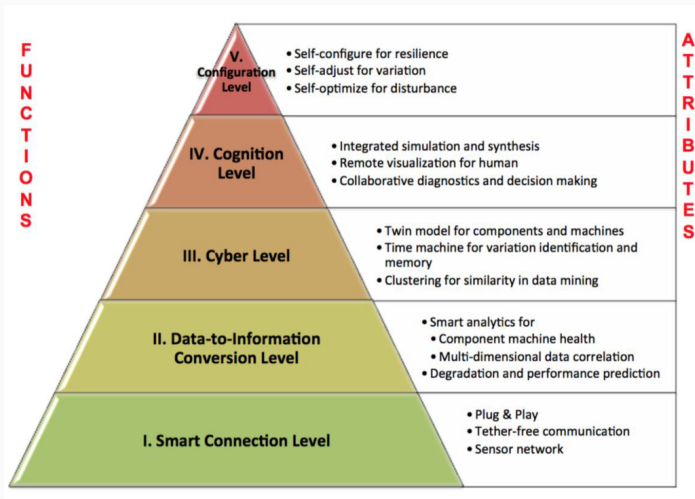
<sup>5</sup>Source: <http://iot.ieee.org/definition.html>

Is a model for enabling:

- ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) <sup>6</sup>
- these resources can be rapidly provisioned and released with minimal management effort or service provider interaction.<sup>6</sup>

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<sup>6</sup>Source: <http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf>



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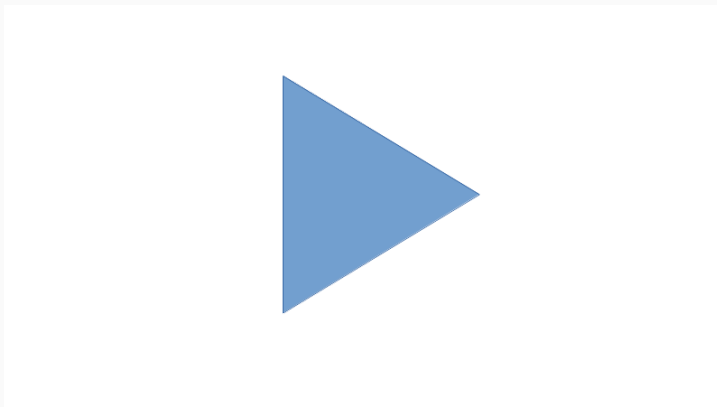
<sup>7</sup>H. Kao, W. Jin, D. Siegel and J. Lee, A Cyber Physical Interface for Automation Systems—Methodology and Examples, Machines 2015, 3(2), pp. 93-106.

# LATEST ROBOTIC RESEARCH TOPICS

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# INTERACTIVE PERCEPTION

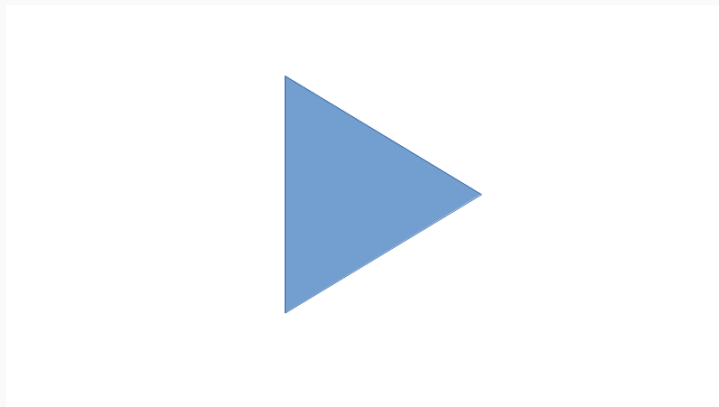
Perception facilitated by interaction with the environment:



Source: youtube.com; RBO TU Berlin channel

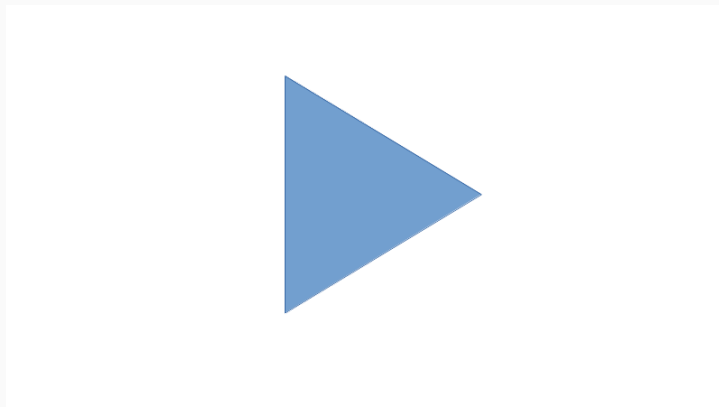


Robots in long term scenarios:



Source: youtube.com; Tom Krajnik channel (Postdoc Univ. Lincoln)

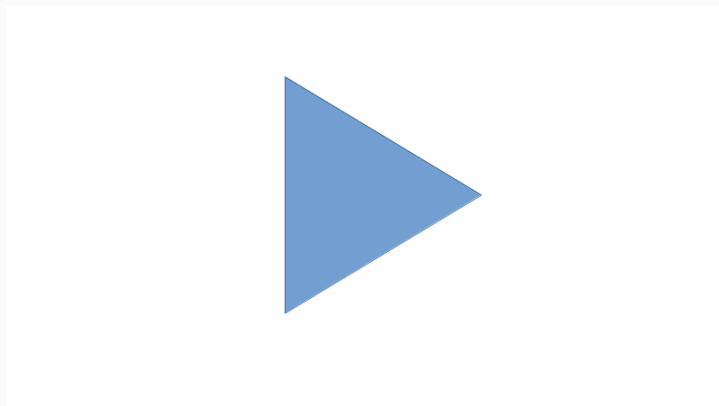
Large Scale data collection:



Source: youtube.com; Peter Pastor channel (Robotician at Google)

## SEMANTIC WEB IN ROBOTICS APPLICATIONS

Knowledge sharing and exchange among several robotic platforms or application:



Source: youtube.com; RoboEarth Final Demonstrator

# CONCLUSIONS

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- Industry 4.0 relies heavily on Internet services
- latest robotic research is getting to the point where knowledge is shared across the network
- exploitation of the knowledge available in the Internet for faster and better robotic learning

e-mail: [krzysztof.walas@put.poznan.pl](mailto:krzysztof.walas@put.poznan.pl)

THAN YOU FOR YOUR ATTENTION.