CAMOZZI GROUP & ICYPHY: COLLABORATION OVERVIEW

CAMOZZI
Automation

ICyPhy Mini-Workshop – 02/14/2019

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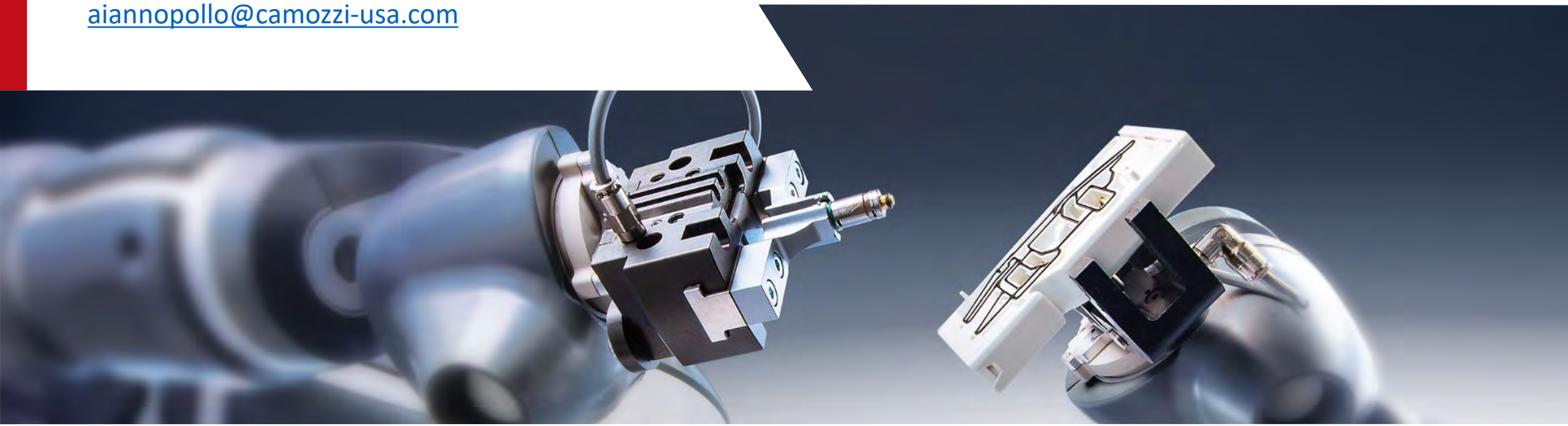


OUTLINE

- Company Introduction
- Research Overview
  - Wireless Sensor Networks for Industrial Applications
  - Predictive Maintenance Framework
- Conclusion

SOME HISTORY FIRST…

1964
Foundation
In 1964 in Lumezzane (BS), the three brothers Attilio, Luigi and Geromino Camozzi started the production of pneumatic components

11
Companies
Over the years the Group has grown and diversified its business that is currently divided into five operating divisions that comprise 11 companies

2600
Employees
In 2017 the Camozzi Group counts more than 2500 employees all over the world

€ 394 M
Turnover
The Group's turnover in 2017 has been 394 Million €

EXP 85%
ITA 15%
Sales
The total direct export of the Group in 2017 represents 85% of the turnover

17
Production Plants
The production plants are located in Italy, Russia, China, India and the U.S.A.

30
Subsidiaries and workshops
Camozzi's network is present in more than 75 Countries through subsidiaries, workshops and distributors

GROUP STRUCTURE

CAMOZZI Automation

CAMOZZI GROUP

CAMOZZI AUTOMATION division

- CAMOZZI Automation — Solutions for industrial automation

CAMOZZI MACHINE TOOLS division

- INNSE BERARDI Machine Tools — Machine Tools, Mechanical and Hydrostatic technology
- INGERSOLL

CAMOZZI TEXTILE MACHINERY division

- MARZOLI Spinning Solutions — Textile machinery and components for short-staple fiber processing

CAMOZZI MANUFACTURING division

- MORA Cast & Machining — Iron casting, aluminium casting, machining
- INNSE MILANO Heavy Machining — Heavy machining
- NEWTON Laser Metal Cutting — Metal carpentry
- CAMPRESS Brass Forging — Brass forging
- CAMOZZI Technopolymers — Plastic injection moulding

CAMOZZI DIGITAL division

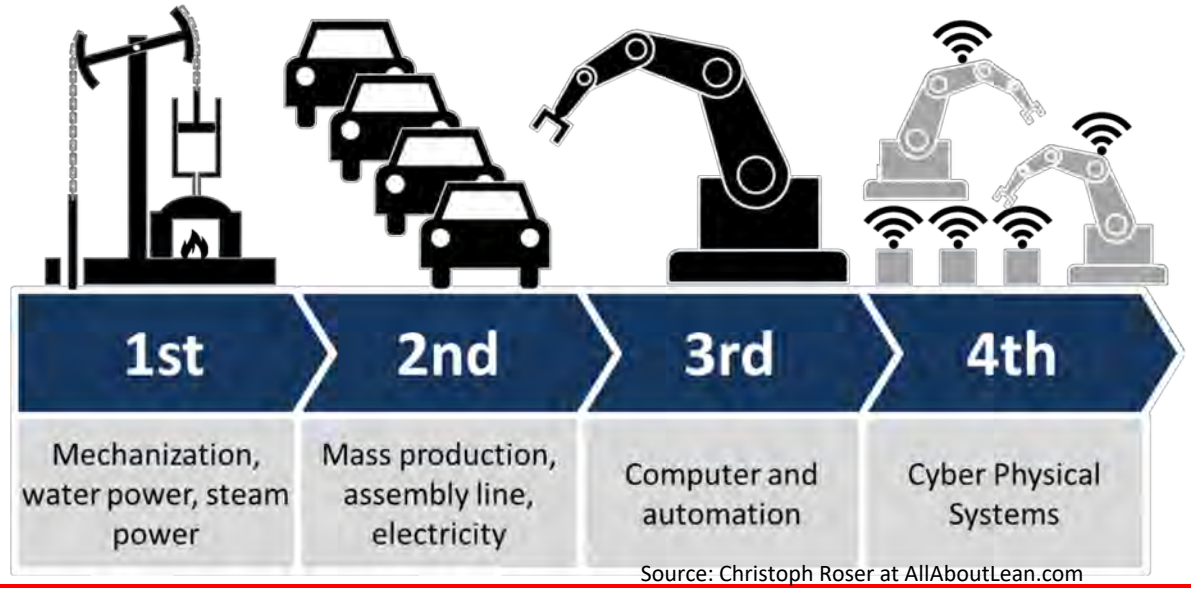
- DIGITAL Industrial Cyber-Physical Systems — Digital Innovation and IoT solutions

MARC — Mechatronic Application Research Center

RESEARCH FOCUS AREAS

From traditional factories to Industry 4.0, leveraging:

- Internet Of Things & Big data
- Advanced Analytics and Artificial Intelligence
- Augmented/Virtual Reality
- Advanced Robotics
- Additive Manufacturing



Source: Christoph Roser at AllAboutLean.com

WIRELESS SENSOR NETWORKS FOR INDUSTRIAL APPLICATIONS

CAMOZZI
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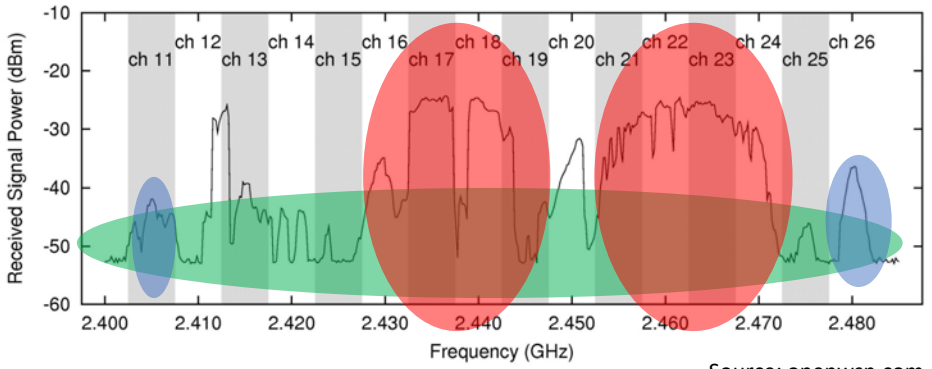
Desirable properties

- Low cost
- Low power
- Robust & Reliable



Source: openwsn.com

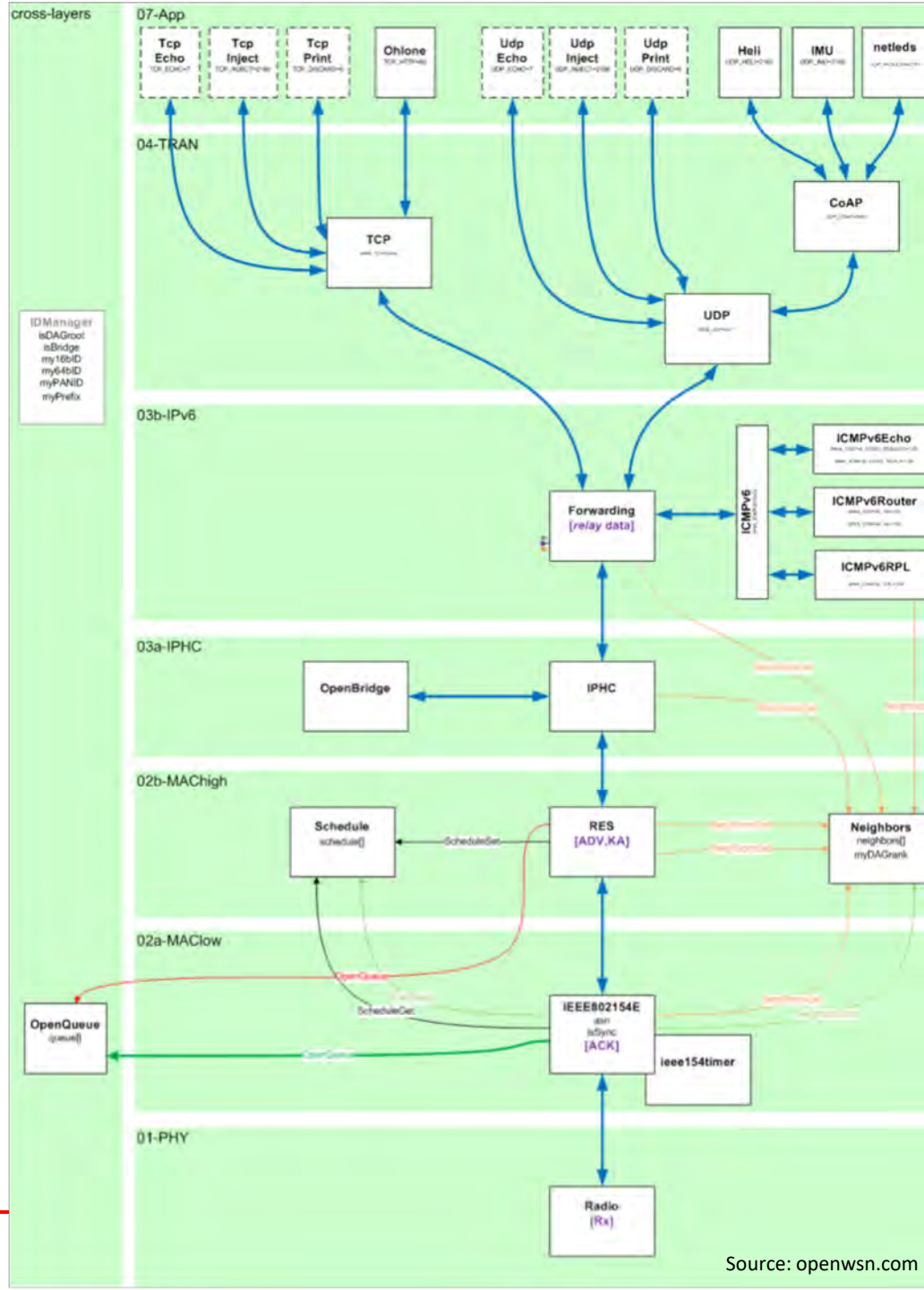
Problems

- Environment is particularly noisy
  - Multiple networks sharing the same channels
- Working conditions and requirements change all the time
  - Need for a network platform

THE OPENWSN APPROACH

- Developed in Berkeley (Swarm Lab) by Thomas Watteyne, Kris Pister, et al.
- Protocol stack for the IoT
- Time synchronized!
  (Time Synchronized Channel Hopping - TSCH)

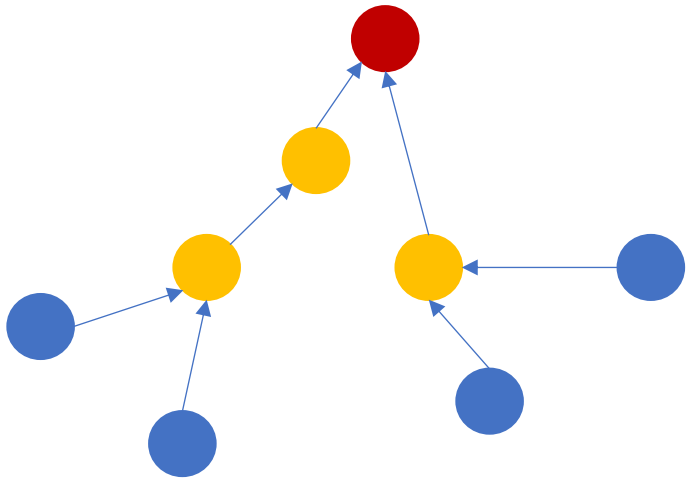
- Robustness to interferences
- Improved utilization of the medium
- Energy efficient



Source: openwsn.com

ADVANTAGES OF TSCH OVER ZIGBEE

Zigbee network

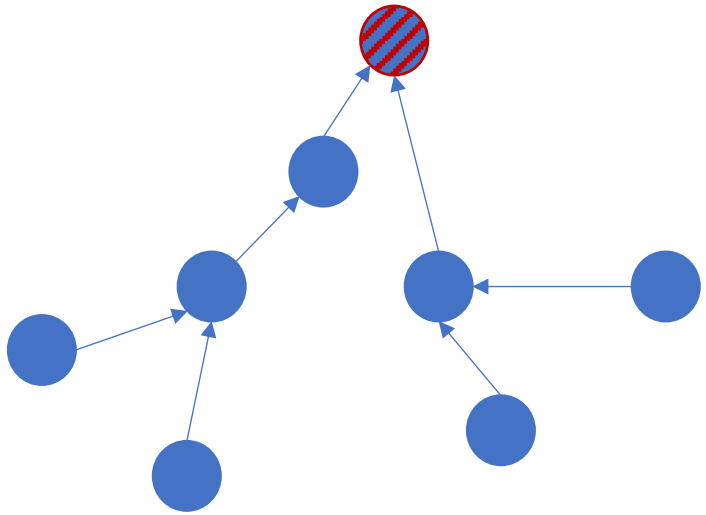


Coordinator

Router

Sleepy Node

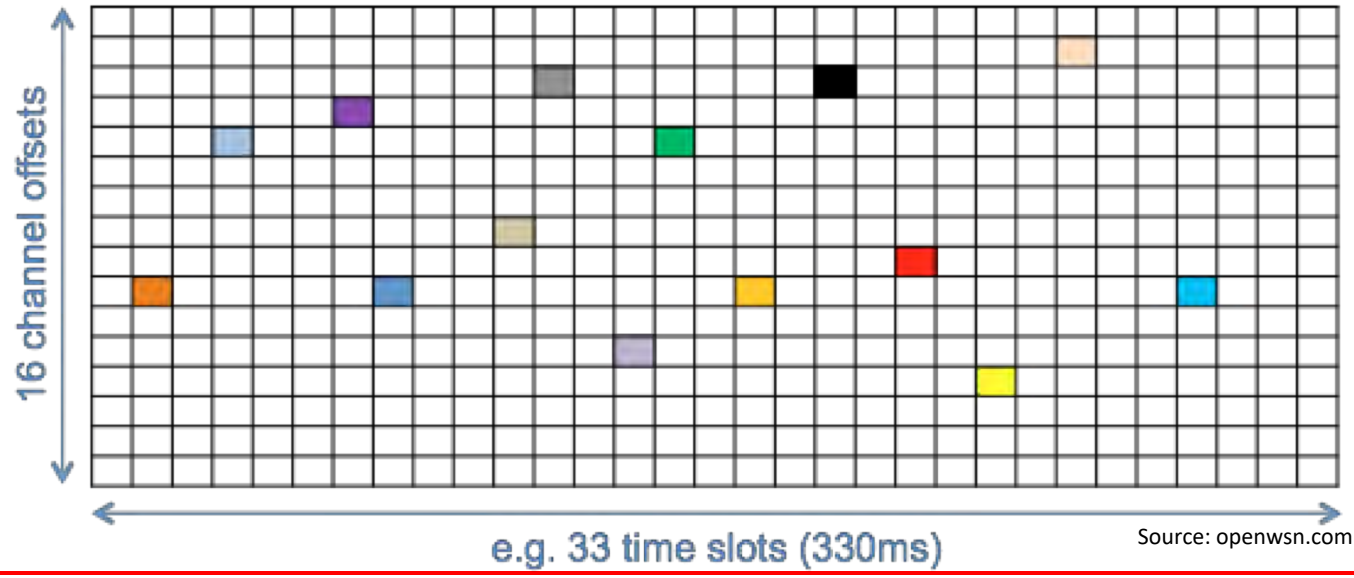
TSCH-based network



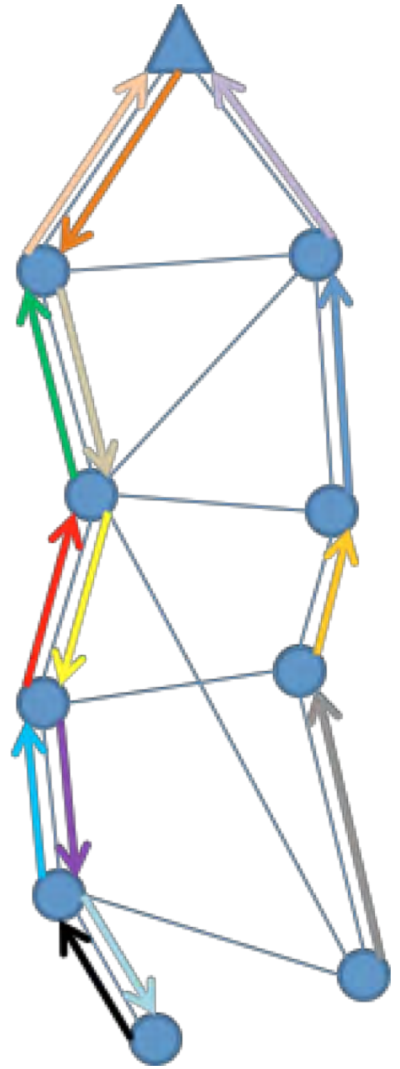
In TSCH, nodes can both be sleepy AND route messages

TSCH: SLOTTED STRUCTURE

- Cells are assigned according to application requirements
- Tunable trade-off between
  - packets/second
  - latency
  - robustness
  - energy consumption



Source: openwsn.com



TSCH-BASED WSN

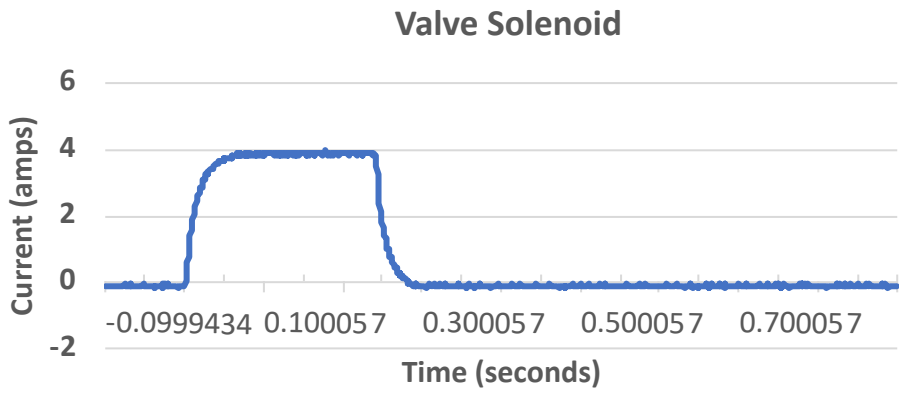
- We are using (and contributing) to an open-source IoT operating system, Contiki-NG, derived from OpenWSN

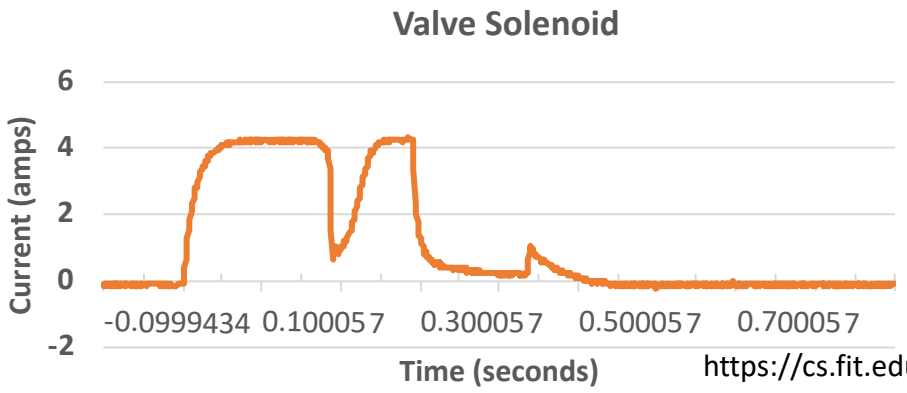
- We are building a platform to support new applications, such as enabling preventive maintenance on old equipment

PREDICTIVE MAINTENANCE FRAMEWORK

Problem

- Component failures result in unpredictable costs
- Preventive maintenance allows to minimize downtime
- Components in this case can be valves, motors, etc.
- The best solution is to build a model of a component and identify meaningful features (but not always possible…)





https://cs.fit.edu/~pkc/nasa/data/

PREDICTIVE MAINTENANCE FRAMEWORK

- Explore a more general approach based on Neural Networks (NN)
- Work initiated by Baihong Jin

Problem characteristics

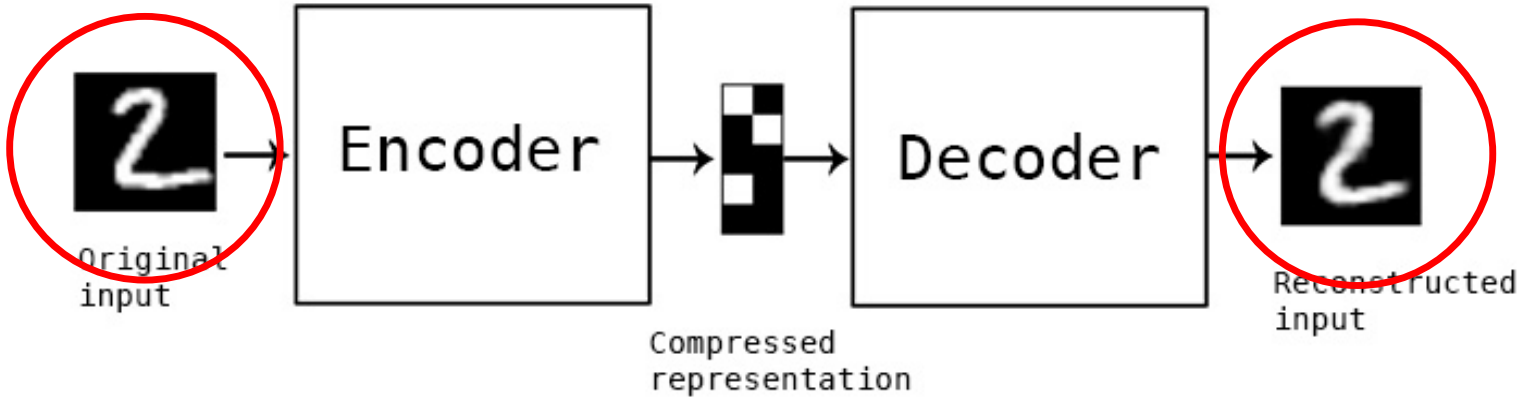
- We have a lot of “good” traces, but few negative ones
- Each component might have unique features (signature)

Idea:

Learn to reconstruct a good trace, and measure the reconstruction error

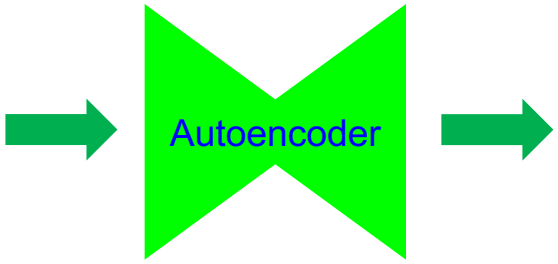
How? Autoencoders (AE)

AUTOENCODERS



Source: keras.io

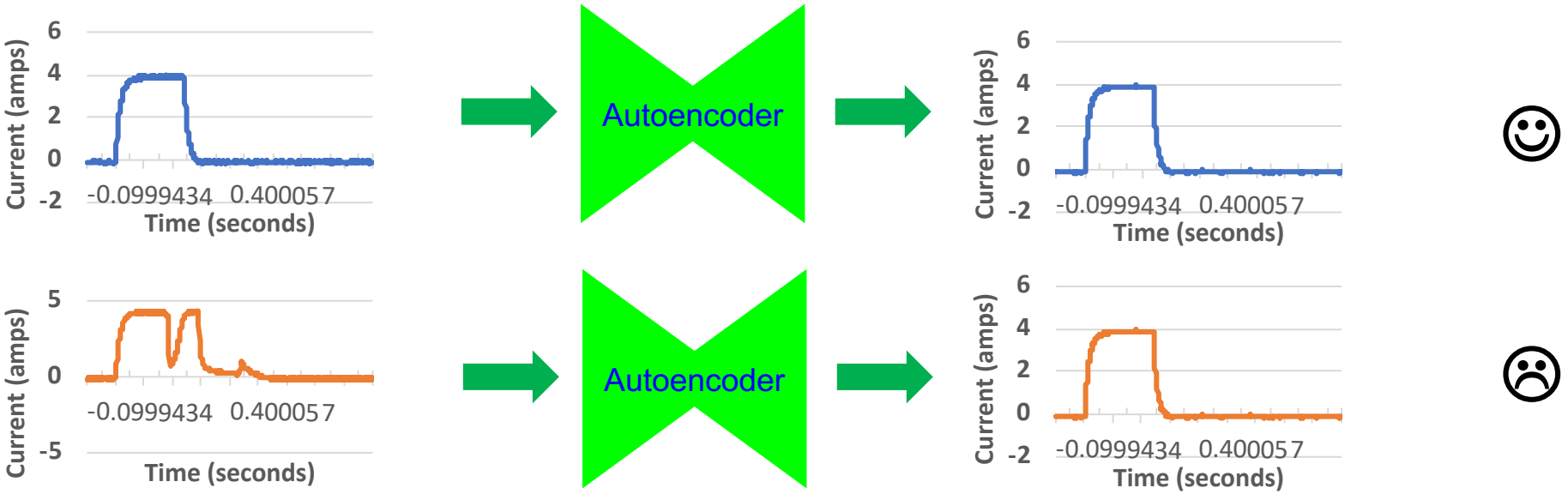
- Special NN used to learn compact data representations
- Useful for
  - Data denoising
  - Dimensionality reduction for data visualization
  - Anomaly detection
- Error is measured as the difference between output and input



AUTOENCODERS

To detect anomalies, first train the AE only on good examples. Then, we'll have:

- low error for normal inputs
- High error for anomalous scenarios



CONCLUSION

- We are working on projects relevant to smart factories and Industry 4.0
- Collaboration with iCyPhy is generating productive synergies

THANK YOU

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A Camozzi Group Company

www.camozzi.com