



Cognitive Cyber-physical Systems: from theory to practice

Ph. D. and Master Course

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Information about the course

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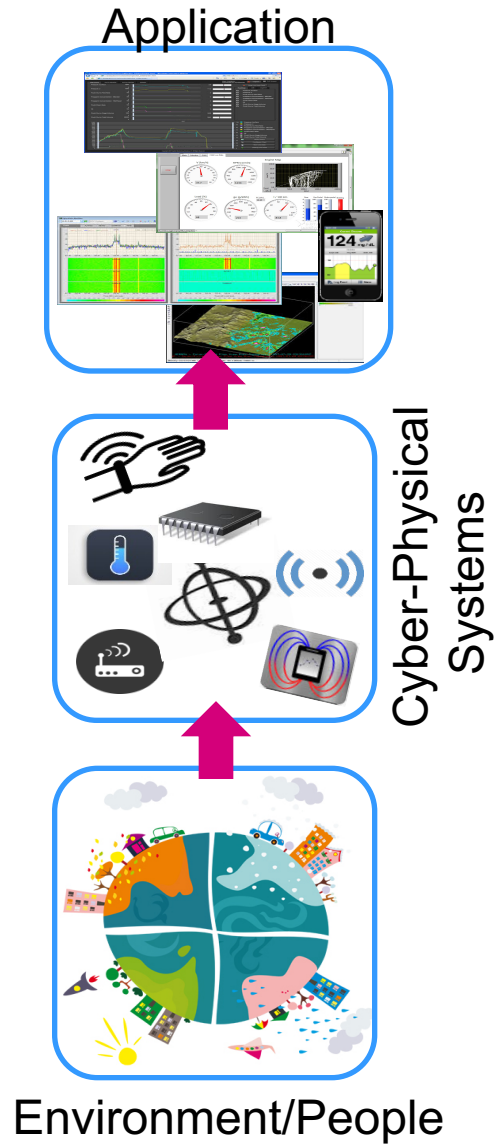


From the environment to Cyber-physical Systems, from the Cyber-physical Systems to the applications

- The **emergence of non-trivial embedded sensor units, networked embedded systems and sensor/actuator networks** has made possible the design and implementation of several sophisticated applications
- Main characteristic: **large amounts of real-time data** are collected to constitute a *big data* picture as time passes.
- Acquired data are then processed at local, cluster-of-units or server level to **take the appropriate actions or make the most appropriate decision.**

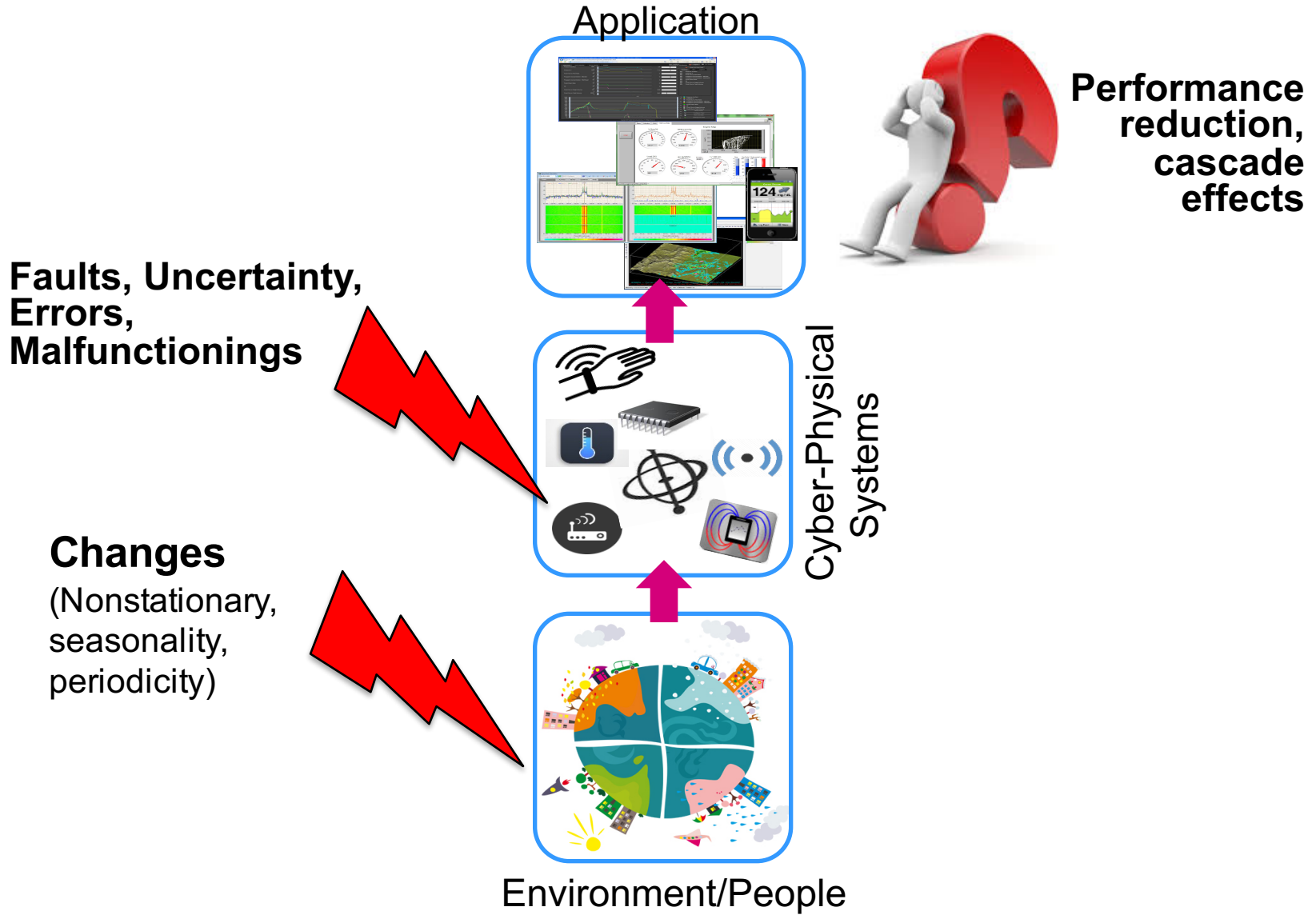


Cyber-Physical Embedded Systems: Introduction





Cyber-Physical Embedded Systems: Challenges



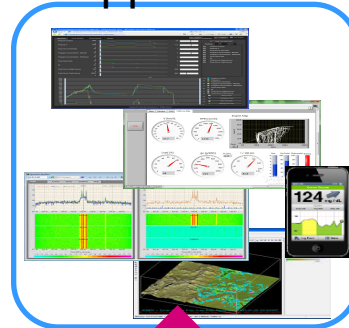


Cyber-Physical Embedded Systems: Challenges vs Application Scenarios

Monitoring of Critical Infrastructure Systems and environments



Application



Healthy and fitness systems



Cyber-Physical Systems



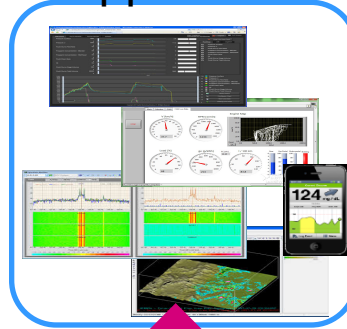
Environment/People



Cyber-Physical Embedded Systems: two POLIMI research projects



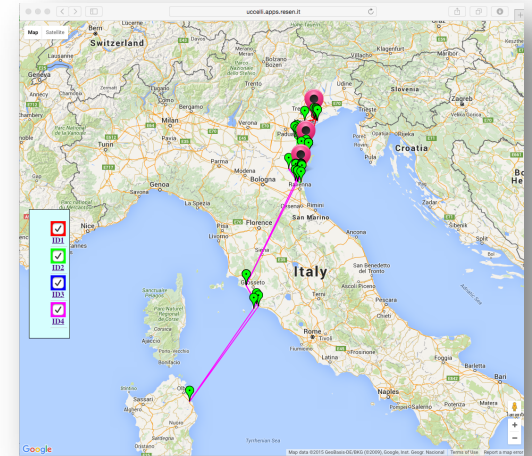
Application



Cyber-Physical
Systems

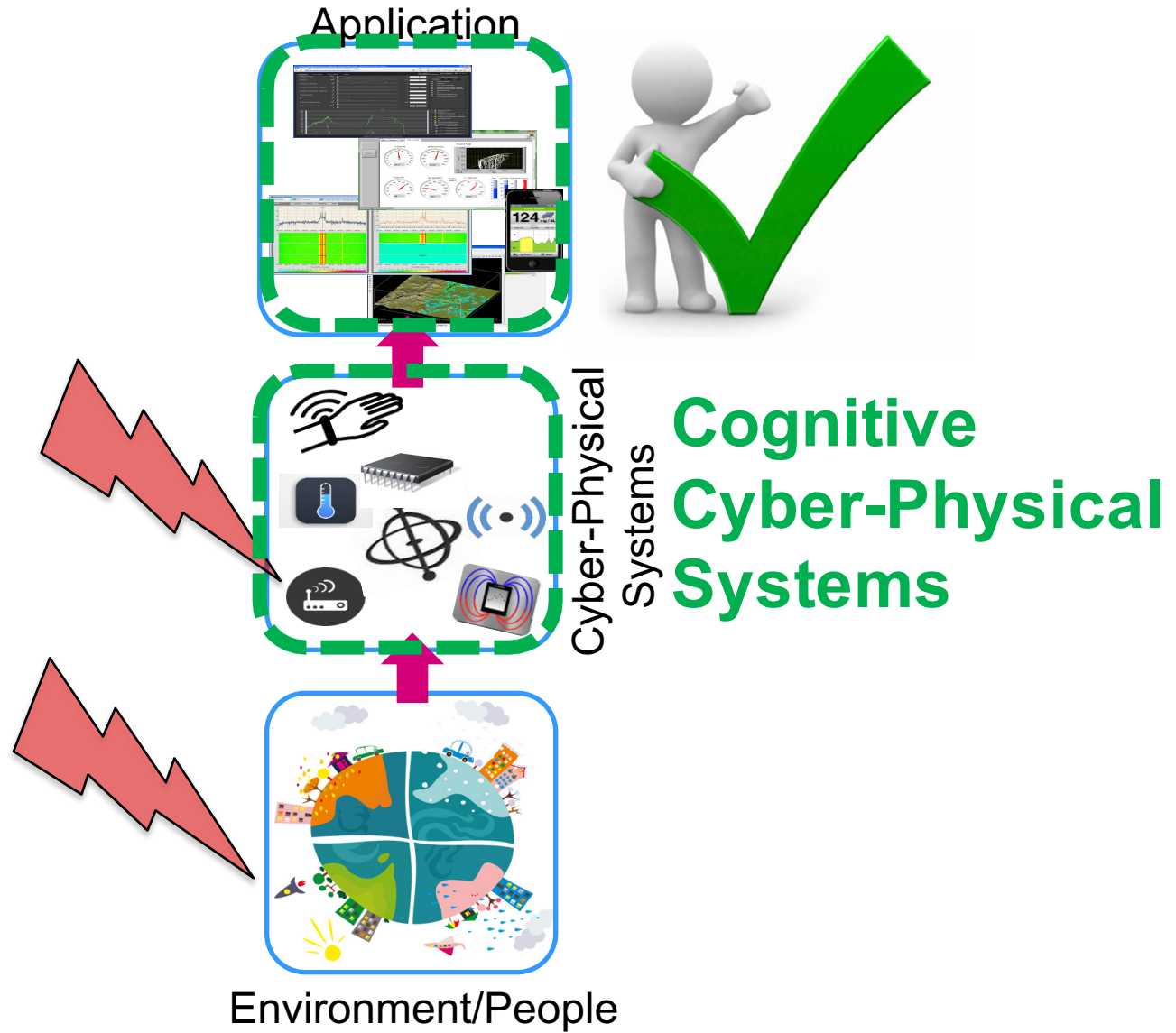


Environment/People





Designing Cognitive (Intelligent, Model-free) Cyber-Physical Embedded Systems





The theoretical framework: three milestones

- All the above definitions, explicitly or implicitly, rely on a **computational paradigm or application which receives and processes incoming acquisitions** to accomplish the requested task.
- Under this framework, **the literature generally assumes that sensors are fault free, that data are stationary, time invariant, available and ready to be used** and that the application is capable of providing outputs and taking decisions.
- Unfortunately, **assumptions about the quality and validity of data are so implicitly taken as valid by scholars that, most of the time, even their existence as assumptions is forgotten.**



How is the course organized?

- This course has been thought for Ph.D. and Master students willingly to learn and understand the technical and technological solutions, and the theoretical and methodological aspects in the design and development of the future generation of cognitive cyber-physical systems:

Theory

- From measurements to smart sensors
- Cognitive (model-free) learning and adaptation mechanisms
- Robustness analysis and PACC
- Cognitive Fault Detection and Diagnosis Systems

Practice

- Designing and developing Cognitive Cyber-physical Systems (Matlab / C Embedded Software)



Schedule of the course

Lesson	Schedule	Room	Time
1	28/01/16	Seminari (DEIB)	13.30-17.30
2	04/02/16	Seminari (DEIB)	13.30-17.30
3	11/02/16	Seminari (DEIB)	13.30-17.30
4	18/02/16	Seminari (DEIB)	13.30-17.30
5	25/02/16	Seminari (DEIB)	13.30-17.30
6	03/03/16	Conferenze (DEIB)	13.30-18.30

Theory

Practice



TEACHING MATERIALS

- **Slides** provided by the lecturers
- **Reference book:**
 - “Intelligence for Embedded Systems: A Methodological Approach”, C. Alippi, Springer, 2014.
Freely downloadable for POLIMI students
- **Selected papers**



- **MathWorks – MATLAB**
 - Download from the POLIMI web site
 - Servizi On Line -> Servizi ICT -> Software Download -> Matlab
- **Codes and Examples** available on the course web page



- **Project/Thesis**
 - Different workloads for Ph.D. and Master Students
 - Up to two people
 - Different skills: Matlab, C/C++, Embedded Software
 - Topics available at the end of the course (but two!)



- All the details can be found at the **course web site**:
 - <http://roveri.faculty.polimi.it/teaching/cognitive-cyber-physical-systems-from-theory-to-practice/>
(Go on my web page and look for the course :-)