



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

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information technology
electrical engineering



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PhD Francesco de Pandi

Cyber-Physical Measurement System

Tutor: Prof. Leopoldo Angrisani

co-Tutor: Prof. Egidio De Benedetto

Cycle: XXXVI

Year: 2020-2021

My background

- MSc Degree in Electronic Engineering
- Electric and Electronic Measurement Department
- PhD start date – 01/11/2020
- Type of fellowship - University

Research field of interest

The research field concerns the *Measurements* and specifically the *Measurement Systems* in their entirety, including the communication protocols designed to connect the distributed elements of a measurement system and the new systems that could be define as new measurement system.

Summary of study activities

Courses:

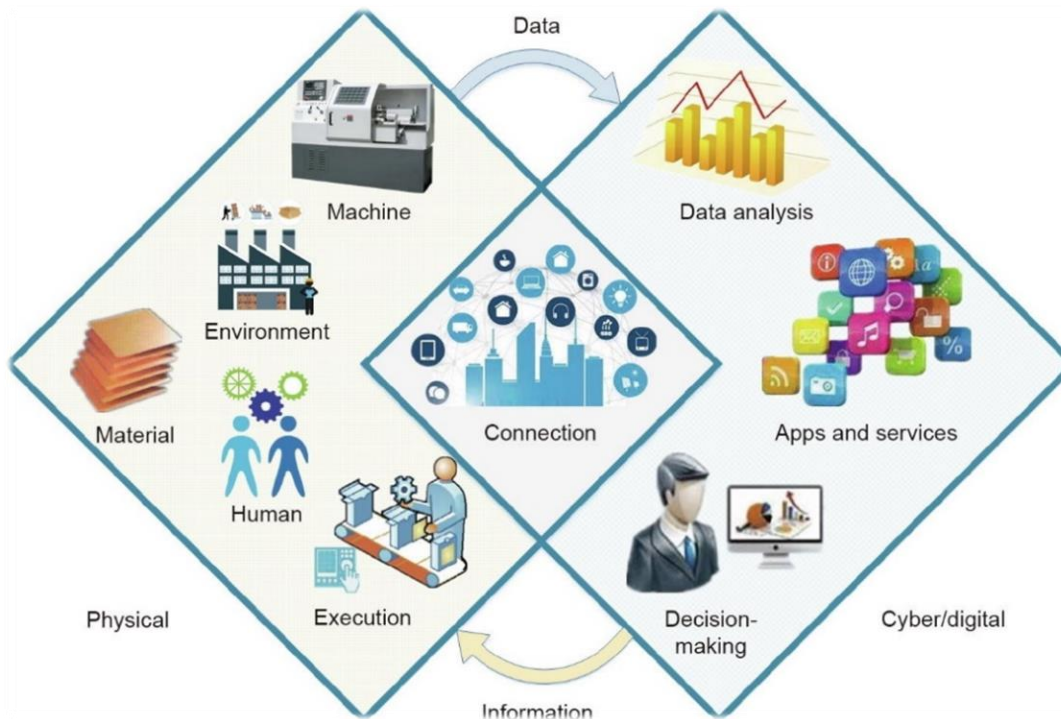
- *Digital Forensics' methods, practices and tools*
- *Corso di modellazione delle scelte discrete*
- *Scientific Programming and Visualization with Python*
- *Statistical data analysis for science and engineering research*
- *Sensors and Smart Metering*

Conferences:

- *IEEE International Instrumentation and Measurement Technology Conference (I2MTC)*
- *28th Saint Petersburg International Conference on Integrated Navigation Systems (ICINS).*
- *IEEE 8th International Workshop on Metrology for AeroSpace (MetroAeroSpace)*

Research activity: Overview

The nowadays systems are called **Cyber-Physical System (CPS)**.

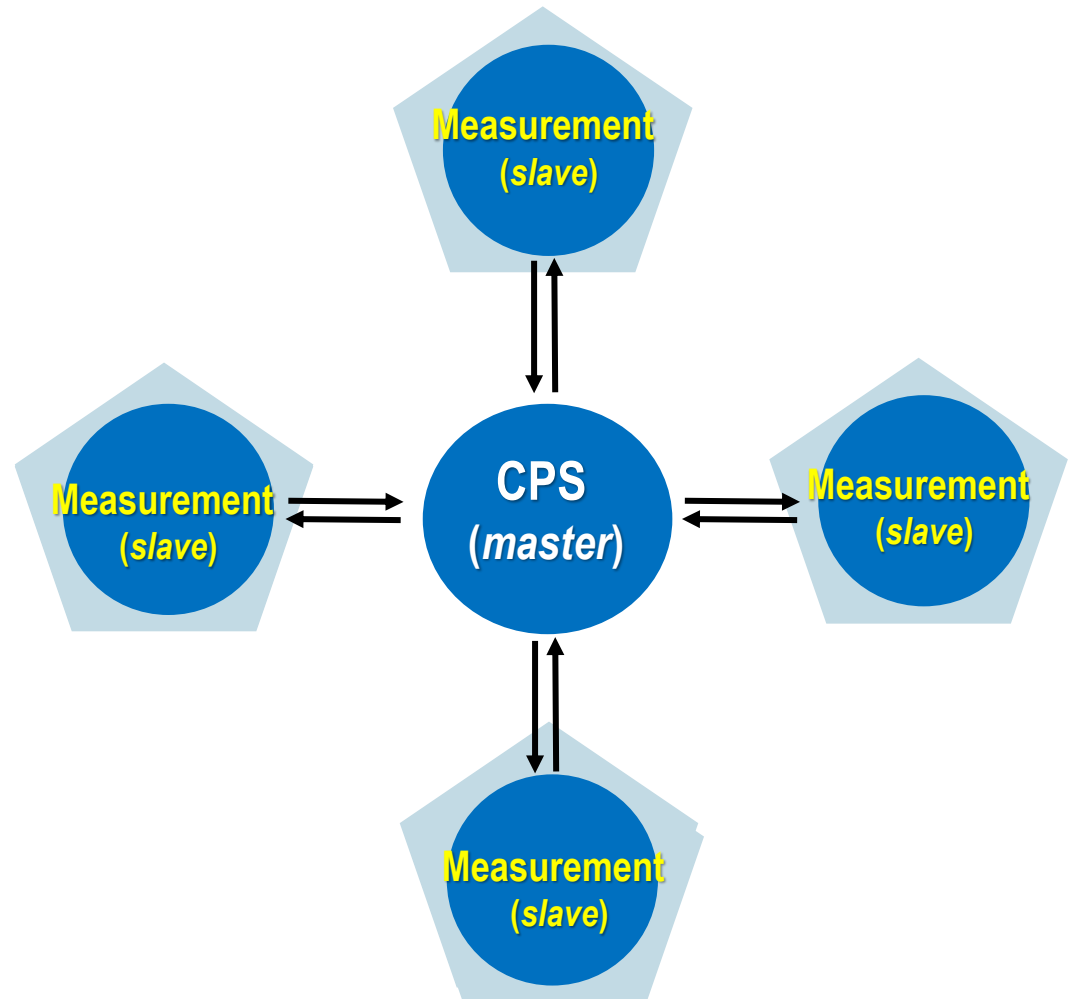


Different parts, **physical** and **digital**, can interact each other in ways that can adapt to the context. The physical part senses and collects data, and executes decisions from the cyber/digital part, while the cyber/digital part analyzes and processes data, and then makes decisions.

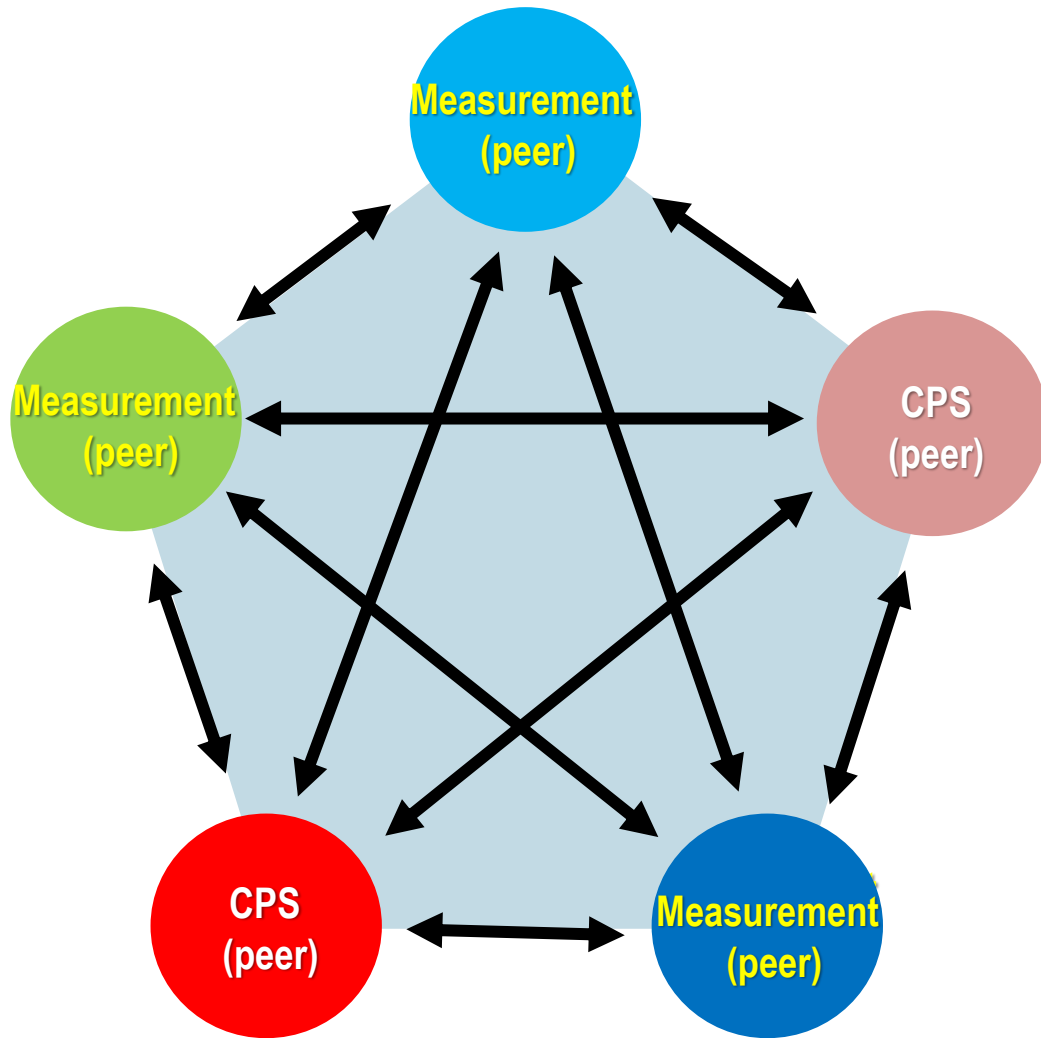
Research activity: Overview

Measurement and monitoring systems (MMSs) are responsible for sensing the conditions from the physical machines and environment, as well as executing control commands.

The coexistence of MMSs, sensors and actuators with the CPS is **mandatory**.



Research activity: Overview

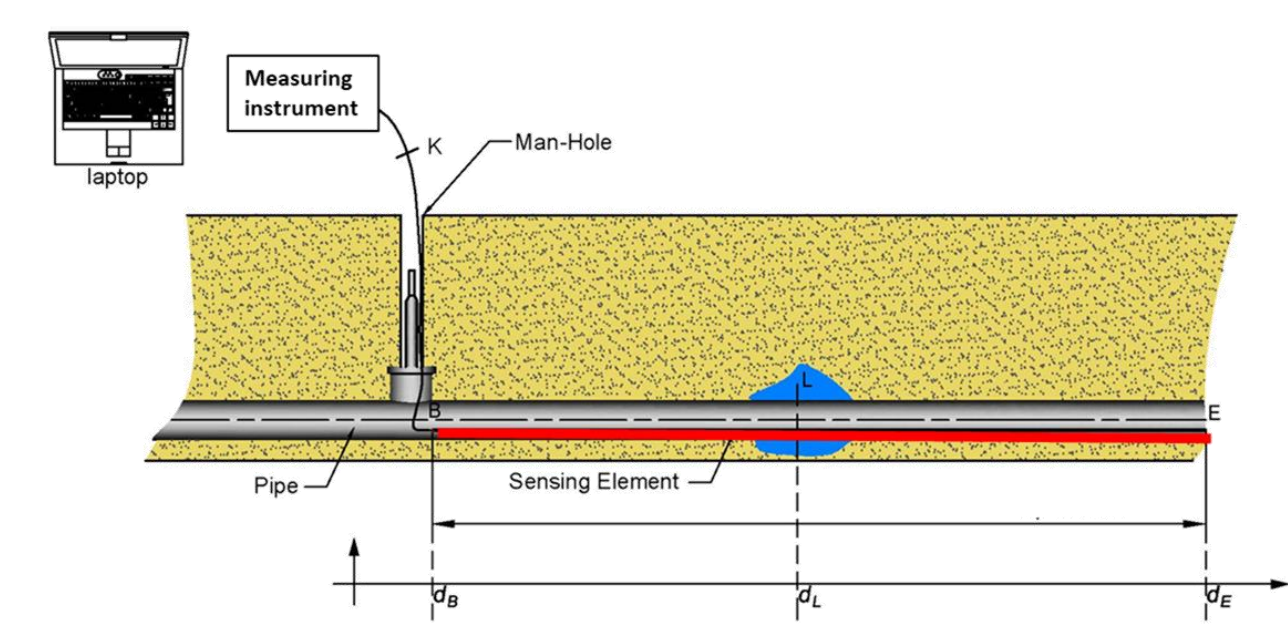


The idea is based on **Measurement System** can become **pro-active** elements in the 4.0 ecosystem. Measurement systems become directly involved in the decision-making process of CPS. So the idea is to make systems have attributes like:












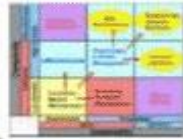


- *self-aware*
- *Self-predict*
- *Self-compare*
- *Self-configure*

Research activity - Problem

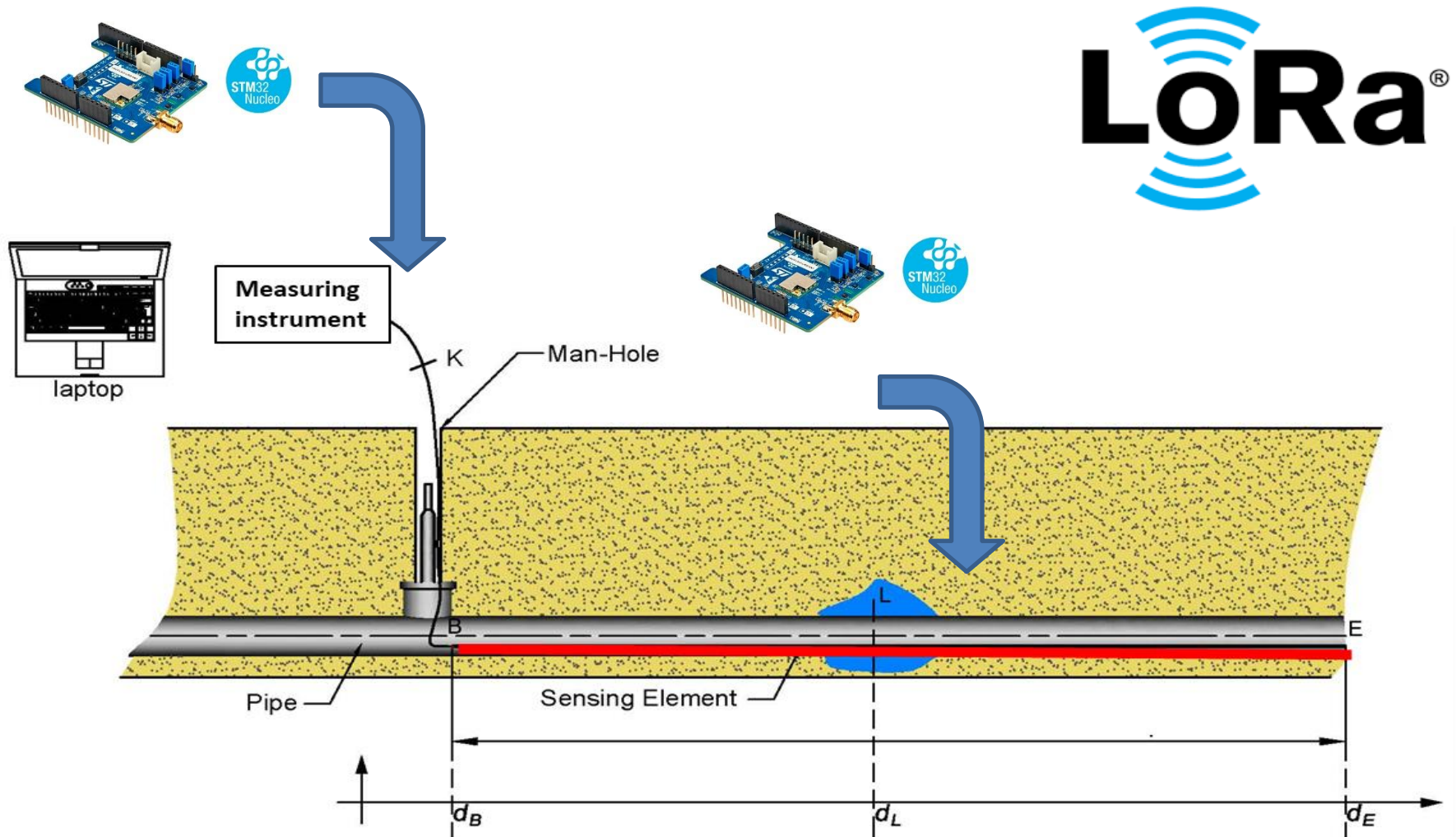
Traditional MMS - Microwave reflectometry-based system for localization of leaks in underground pipes



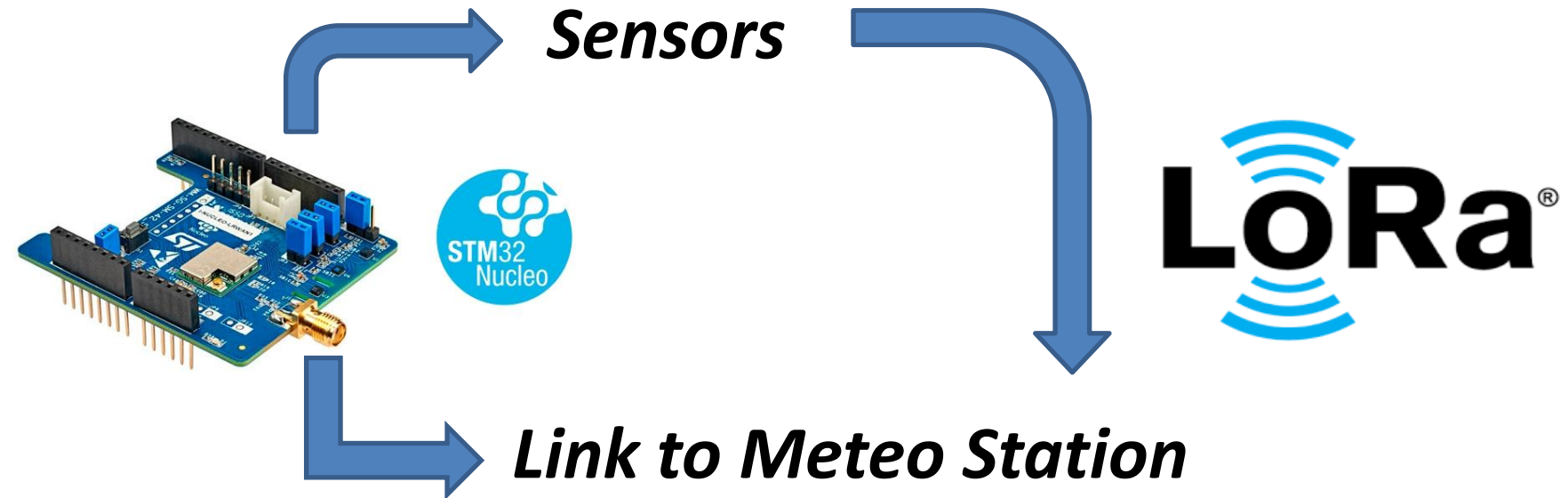
Research activity – Problem

Configure	  	Resilient Control System (RCS)	Actions to Avoid
Cognition	  	Decision Support System (DSS)	Prioritize and Optimize Decisions
Cyber	  	Cyber-Physical Systems (CPS)	Self-Compare
Conversion	  	Prognostics and Health Management (PHM)	Self-Aware
Connection	 	Condition Based Monitoring (CBM)	Condition Monitoring

Research activity – Possible Solution



Research activity – Possible Solution



Products

[P1]	<i>A Multi Objective Evolutionary Algorithm for the Parameters Extraction of Organic Thin Film Transistors Models. Electronics.</i>
[P2]	<i>"Exploiting Augmented Reality and Internet of Things for Gamma Ray Experiments in Educational Field" 2021 IEEE International Instrumentation and Measurement Technology Conference (I2MTC)</i>
[P3]	<i>An Augmented Reality Approach to Remote Controlling Measurement Instruments for Educational Purposes during Pandemic Restrictions. IEEE Transactions on Instrumentation and Measurement</i>
[P4]	<i>Integration of a Sun light Polarization Camera and Latest-Generation Inertial Sensors to Support High Integrity Navigation. In 2021 28th Saint Petersburg International Conference on Integrated Navigation Systems (ICINS). IEEE.</i>
[P5]	<i>Performance Analysis for Human Crowd Monitoring to Control COVID-19 disease by Drone Surveillance. In 2021 IEEE 8th International Workshop on Metrology for AeroSpace (MetroAeroSpace). IEEE.</i>

Future Steps



Future Steps

[P2]	<i>"Exploiting Augmented Reality and Internet of Things for Gamma Ray Experiments in Educational Field" 2021 IEEE International Instrumentation and Measurement Technology Conference (I2MTC)</i>
[P3]	<i>An Augmented Reality Approach to Remote Controlling Measurement Instruments for Educational Purposes during Pandemic Restrictions. IEEE Transactions on Instrumentation and Measurement</i>

Can The Augmented Reality be used as a Measurement System itself?