

**Title:** Measurement systems for localization

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**Indicative period:** December 2022 – February 2023

## **ABSTRACT.**

Information about the position of users, structures, and systems is crucial in many engineering applications. This course presents an overview of the main characteristics and requirements of location-aware applications in several operating scenarios, together with the fundamental electronic measurement techniques. Methods and algorithms for static position estimation and dynamic tracking are also described.

## **PROGRAM**

### **1 – Electronic systems for short-range distance measurement and positioning:**

Characteristics and requirements of location-aware applications. Performance of available solutions: radio-frequency systems (Ultra-wideband, wireless personal area network), ultrasound systems, magnetic-field-based systems, integration with satellite positioning and navigation systems.

### **2 – Position measurement techniques:**

Time-of-flight measurement: Time of Arrival, Time Difference of Arrival, Round-Trip-Time.

Power measurement: Received Signal Strength.

Direction measurement: Angle of Arrival.

Processing techniques: trilateration, triangulation, fingerprinting, dead reckoning.

### **3 – Methods and algorithms for position estimation:**

Tracking, sensor fusion, seamless indoor-outdoor positioning.

### **Suggested reading:**

- Z. Sahinoglu, S. Gezici, I. Guvenc, *Ultra-wideband Positioning Systems: Theoretical Limits, Ranging Algorithms, and Protocols*, Cambridge University Press, 2011.
- Study material provided by the instructors