Optional course : code UE HAE932E

Optical and thermal sensors with associated systems (5 ECTS)

Learning Outcomes:

- To establish the foundations of the infrared radiometric chain, from the emission of radiation by a source brought to a certain temperature to the absorption of the radiation by the sensor or sensor system (camera). The main optical and thermal infrared detectors will be discussed. Then, the student will apply these theoretical foundations through the fabrication and the electro-optical characterization of a photodiode, its implementation within a measurement chain. Student will also use a latest-generation thermal camera to carry out infrared thermography measurements.

Description :

- Thermal detectors
  - Photometric measurement and infrared radiation Introduction: chain and optical system- Photometry - optical radiometry Electromagnetic spectrum, Optical source, Definition: Flux, Intensity, illuminance, units etc…Relationship between quantities, Spectral size
  - Thermal sensing Thermal recall, Relationship between incident flow and heating, Mounting and sensitivity calculation, PEB and detectability for the following detectors I- Bolometer II- Thermopile III- Pyroelectric sensor
- Optical Detectors for Night Vision Imaging
  - Infrared Optical Detectors and Infrared Imaging (IR).
    - Context of infrared radiation Black body, spectral emissivity, thermal contrast, bispectral imaging, passive and active imaging, applications.
    - Infrared Photodetectors Principles of operation The different generations of photodetectors The different quantum detectors and comparison with thermal detectors, Performance limits and quality criteria Manufacturing of photodetectors and IR imagers, performance.
    - Characterization of IR photodetectors.
    - Current Commercial Offering for IR Imaging
  - Visible Optical Detectors and Residual Light Intensification (IL) Imaging.
    - Context of a scene with low photon flux and associated photometric quantities. Flows, Albedo, Luminance, Lighting, Emittance …
    - Night vision tube Photoemission Principle, Detection and Photomultiplication. IL imager. Night vision application
    - Next generation IL imager, Fusion sensors
    - Current Commercial Offer for IL Imaging C- Case study: I- Order of quantities and digital applications – Performance II- Choice of materials and implementation constraints (specifications), in the case of needs and applications Specific – Purchases
- Labs : IR camera and microsensors fabrication (clean-room)