Description of the specialization

I. PHYSICAL SENSORS

1. Spot and distributed optic fibre sensors, in particular employing microstructural optical wires, for measuring physical quantities, in particular shape, deformation, temperature and others.
2. Technology and structure of sensors and detectors of electromagnetic and/or ionizing radiation.
3. Technology and structure of sensors employing ultrasounds.
4. Technology and structure of sensors and microsensors (MEMS/NEMS/MOEMS), including for mechanical quantities (force, tension, deformation, acceleration, vibrations, position and others).
5. Development of flexible and/or printed sensors.
6. Technology and structure of electric and magnetic sensors.
7. Sensors for material diagnosis, including non-destructive tests.
8. Navigation systems in closed objects.
9. Physical sensors for automatic diagnosis of machines and devices in M2M or M2H systems.
10. Sensors for weight and force measurements, including dynamic measurements.

II. CHEMICAL SENSORS

1. Development of new construction solutions and a technology for producing chemical sensors, including the electrochemical, semiconductor, thermometric, mass, optic and optical fiber, lab-on-chip, spectrometer, resonance (MEMS/NEMS) and others.
2. Matrices for chemical sensors.
3. Chemical sensors for gases (photonic, conductometric and others).
4. Techniques and materials for functionalising chemical sensors
5. Chemical sensors, detectors and sensor networks for monitoring chemical and radiological security level.

III. BIOSENSORS

1. Sensors for bioelectrical measurements of the parameters of living organisms and biological structures.
2. Sensors for biomechanical measurements of parameters of biological structures.
3. Techniques and materials for functionalising biosensors.
4. Technology and structure of biosensors employing MEMS and NEMS structures.

5. Biosensors matrices.
6. Optoelectronic sensors employing biological structures (enzymes, proteins, nucleic acids
   and others).
7. Sensors for monitoring the vital functions of people operating in extreme conditions (firefighters, rescuers, policemen, athletes and others).
8. Sensors and sensor networks for telemedicine, including monitoring human health.
9. Sensors for biomedical implants.
10. Sensors for biomedical signals for devices control.

IV. SENSOR NETWORKS

1. Techniques of management, optimisation and self-organisation of sensor networks.
2. Security of sensors and sensor networks as well as security systems for data transmission and collection.
3. Localisation in sensor networks (localisation algorithms, techniques for localisation and creation of maps,
   in particular dedicated to areas of high risk and/or difficult propagation conditions).
4. Techniques for processing and collecting data for sensors and sensor networks.
5. Artificial intelligence techniques supporting the functioning and use of intelligent sensor networks.
6. Smart sensors and sensor networks employing acoustic, seismic, spectral and/or imaging techniques.
7. Development of sensors and sensor networks of Body Area Network type (BAN).
8. Development of new solutions for autonomising the functioning of sensor networks.
9. Sensor networks for monitoring the condition of the human environment.
10. Sensor networks for monitoring land, air and water traffic, including radars with a controlled beam.
11. Smart sensor networks supporting trade, in particular electronic, and systems integrating electronic sales channels with traditional channels.

V. HORIZONTAL (CROSS-SECTION) NOTIONS IN SENSOR TECHNOLOGIES

1. Electronic and IT technologies for sensor systems.
2. Innovative materials for laser technology.
3. Techniques and systems for efficient consumption of energy for autonomous sensors and sensor networks.
4. Instruments and systems for energy harvesting for sensors and sensor networks.

5. Sensor operating within extreme environmental conditions.
6. High resolution and high accuracy sensors.
7. Housing and packaging technologies for sensor and detector technology.
8. The notions of integration and miniaturisation of heterogeneous and smart sensor systems.
9. Methods for improving reliability of sensors and sensor systems.
10. Sensors of physical and chemical quantities as well as electronic support systems that work
    in harsh environment, including cosmic conditions.
11. Utilisation of data fusion collected by various types of sensors.
12. Microelectronic systems, including specialised ASIC integrated circuits for the needs of sensors and sensor networks.
13. Sensors and sensor networks for biomedical diagnosis.
14. Sensors and sensor networks for prevention in situations of public safety and/or epidemiological threat.
15. Sensor networks for managing the security of critical infrastructure and public facilities.
16. Sensors and smart sensor networks for the needs of disabled persons and for rehabilitation.
17. Sensors and sensor networks for monitoring technical condition of engineering structures
    and/or prediction of the period of their safe exploitation (SHM and PHM).
18. Functional sensors and sensor networks for technical devices.
19. Sensors and sensor networks for smart buildings and cities.
20. Sensors for monitoring natural environment.
21. Sensors and sensor networks for the needs of modeling people, their behaviour and environment (work ergonomics, creation of virtual environments and others).
22. Sensors and sensor networks supporting agriculture, forestry and agri-food industry.
23. Sensors and sensor networks for modelling, simulating, controlling and/or operating of the technological processes in industry.
24. Sensors and sensor networks for monitoring storage conditions in the supply chain and tracking products for identification purposes.
25. Sensors and sensory networks for the needs of advanced systems of perimetric protection.
26. Sensors and sensory networks for the needs of controlling machines with gestures and speech.
27. Sensors and smart sensor networks for locating people and things in a dynamically changing environment in a limited area.
28. Sensors and sensor networks for adaptive anti-collision and anti-crash systems

in transport and industry.

Dictionary:

MEMS (*MicroElectroMechanical Systems*) – a microsystem that is most often produced using semiconductor technology, consisting of mechanical and electrical components.

NEMS (*NanoElectroMechanical Systems*) – a microsystem that is most often produced using semiconductor technology, consisting of mechanical and electrical components, including elements
in nanometric sizes.

MOEMS (*MicroOptoElectroMechanical Systems*) – a microsystem that is most often produced using semiconductor technology, consisting of mechanical, optical and electrical components.

Body Area Network – a sensor network, the elements of which are located on or inside living organisms.

SHM (*Structural Health Monitoring*) – monitoring technical condition of a structure.

PHM (*Prognostics Health Monitoring*) – management and prediction of the lifetime of the structure.

M2M (*Machine to Machine*) – Communication between machines.

M2H (*Machine to Human*) – Communication between a human and a machine.

Harsh environment – difficult environmental conditions (e.g. outer space conditions, mining, metallurgy).