State doctoral exam topics (SDE)

Doctoral study programme P0716D060002 Aeronautical and Space Engineering

Aircraft Avionics

1. Aircraft instrumentation, used sensors.
2. Electromagnetic compatibility in avionics.
3. Aircraft power sources, power distribution, and networks.
4. Principles in evaluation of engine and pilotage-navigation parameters.
5. Complex systems and methods used in engine health monitoring systems.
6. Avionics of unmanned aerial vehicles.
7. New principles, approaches, and technologies in aircraft instrumentation. Current research in the field of aircraft technologies.

Computational avionics

1. Navigation concept PBN (RNAV and RPN), use, principles and differences
2. Concept of failure detection isolation and recovery (FDIR), flow diagram of error propagation
3. Complementary filter, principle and extension into the Kalman filter
4. Principles of avionic systems certification
5. Aerospace sensors and systems: engine monitoring sensors, FADEC, GPWS, INS
6. Artificial intelligence and state space search: breadth and depth search, UCS, A*
7. Data buses: ARINC429, CAN, CAN aerospace, TTP,

Navigation systems

1. Coordinate systems and coordinate transformation.
2. Radio navigation methods. Aeronautical navigation systems.
3. Satellite navigation systems and augmentation systems. DGNSS, SBAS
4. Propagation and processing of the navigation signals.
5. Ionospheric reflection, modeling, dual and multiple frequency measurements, multipath mitigation methods
6. Methods for calculation of the navigation satellite positions, position errors, DOP
7. Carrier phase navigation methods, ambiguity resolution, RTK, Precise Point Positioning methods
8. Inertial navigation systems, mechanization of the navigation equations, sensors.,
9. Applications of Kalman Filter in aided navigation systems. Data validation, dynamic detection.
10. Indoor navigation
11. Application of the navigation in science

Image Processing and Photonics

1. Space image photonic systems, selected missions
2. Fermat's principle
3. Geometric and wave optic
4. Imaging systems – parameters, measurements and calibration
5. PSF, MTF, OTF, spatial resolution, SWATH
6. Wavefront deformation, aberrations, Zernike description
7. Infrared image photonic systems, polarizers
8. AOTF
9. Hyperspectral imaging, remote sensing
10. Image processing algorithms for space applications
11. Telemetry and data compression

Space technology

1. The big Bang Theory; Cosmological principle, late stages of stellar evolution (white dwarfs, neutron stars, black holes), dark energy and dark matter.
2. Space environment, radiation interactions; Solar wind; Solar activity; Plasma interactions with surfaces; Satellite charging.
3. Influence of space environment on satellites. Space debris and micrometeoroids; Problems of heat in vacuum / space
4. Materials for space applications. Passive shielding materials for high energy particles.
5. Rocket types and principles.
6. Satellite orbits. Satellite dynamics, attitude control, actuators, basics of celestial mechanics. Lagrange points and their applications.
7. Satellite buses and their components, energy systems for satellites and space probes.
8. Basic types and applications of artificial satellites. Space communications and antennas.
9. Radiation resistance, space electronics and software, TRL, reliability, ground segment and testing, space flights with humans.

The tutor together with the student select (usually) 25 topics from the list.