Project and Diploma Thesis Topics in DAAS – 2023/2024

Intermediate Project (P)
Engineering Diploma Thesis (E)
Master Diploma Thesis (M)

D.Sc., Ph.D., WUT Professor, Marcin Żugaj

The navigation area

1. Algorithms for sensor data fusion (E,M)
2. Statistical and spectral analysis of sensor signals (P,E)

Dynamics and control

1. Automatic flight control system for manned/unmanned aircraft (E,M)
2. Automatic flight control system based on optimal control approach (M)
3. Flight control system for rotorcraft (P,E,M)
4. Determination and analysis of dynamic characteristics of manned/unmanned aircraft (P)
5. Determination and analysis of manned/unmanned aircraft performance (P)

Dynamics modelling and simulation

1. UAV dynamics modelling and simulation for automatic flight control system design (E,M)
2. Sailplane dynamic modelling and simulation (E,M)
3. Quadrocopter dynamic stability analysis (M)

D.Sc., Ph.D., Full Professor, Janusz Narkiewicz

The area of navigation

1. Sensor fusion in navigation systems on-board of aircraft / spacecraft
2. Novel filtering algorithms for navigation sensor fusion

The area of aeronautical systems

1. Architecture of on – board systems for mobile platforms (spacecraft / land / water / air)

The area of dynamics modeling and simulation

1. Modelling of dynamics and control of mobile platforms

The area of unmanned aerial vehicles

1. Optimization of UAS formation flying.

The area of space technology

1. Various topics related to nanosatellite design, dynamics and control.
2. Spacecraft formation flying.

D.Sc., Ph.D., WUT Professor, Elżbieta Jarzębowska

The area of dynamics and control

1. Implementation of tracking and stabilization control algorithms at the kinematic level to a mobile robot Pioneer 3-DX. (work with ARIA software – the original robot software). (P,E)
2. Dynamics modeling and motion control of a wheeled mobile robot including wheel slipping. (Master)
3. Dynamics modeling and motion control of a multi-link manipulator model with flexible links. The manipulator model selection is up to a student (Master)
4. Dynamics modeling and motion control of a formation of objects (objects are due to a student, e.g. wheeled mobile robots (WMR), unmanned aerial vehicles (UAVs), underwater autonomous vehicles (UAV's), satellites formation, manipulators in duets, e.t.c). (Eng, Master)
5. Implementation of "model-based" tracking control algorithms to a mobile robot Pioneer 3-DX. (Master)
6. Dynamics modeling and motion control of underactuated system models, e.g. acrobot, pendubot, snake-like manipulator, space vehicles and manipulators, biomechanical system models and others (object selection is due to a student). (Eng, Master)
7. Dynamics modeling and maneuver control for underwater vehicles (gliders, ROVs, hybrid propelled vehicles. (Eng, Master)
8. Optimization of control maneuvers for underwater gliders (a glider propulsion way selection is due to a student). (Master)
9. Control design for servicing satellites and space robots (Eng, Master)
10. Tracking controller designs for servicing space missions (Eng, Master).
11. Control design for space missions for servicing satellites and space robots (Eng, Master)
12. Control design for servicing and docking maneuvers of satellites and space robots (Eng, Master)

The area of dynamics modeling and simulation

1. Modeling complex dynamical systems – constrained dynamics models including environmental constraints, friction, joint and motor dynamics. A system is due to a student. (P)
2. Dynamics modeling and simulation tests for motion of complex systems: (P)
   - multi-link ground, space and underwater manipulators,
   - wheleed mobile vehicles, mobile manipulators, car-like vehicles,
   - autonomous systems like UAV's.
3. Dynamics modeling and simulation tests for motion of systems with flexible parts and links: (P)
   - multi-link ground, space and underwater manipulators with flexible arms,
   - wheleed mobile vehicles and platforms with flexible parts and chassis.
4. Dynamics modeling and simulation tests for motion of a mobile robot including tire models and motor dynamics. (E)
5. Dynamics modeling and simulation tests for motion of a mobile robot including wheel slip models. (E)
6. Dynamics modeling and simulation tests for formation of ground autonomous vehicles motion and regrouping in surveillance and patrol missions (vehicles due to a student). (E)

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7. Dynamics modeling and simulation tests for formation of UAV's. (E)
8. Dynamics, motion analysis of a car-like vehicle including wheel slip models. (M)
9. Dynamics, motion analysis of a multi-link manipulator model with flexible arms – simulation studies of flexibility and compliance models. (M)
10. Dynamics, motion analysis of a space robot model with flexible arms – simulation studies of flexibility and compliance models. (M)
11. Dynamics, motion analysis of a space robot model with flexible appendages – simulation studies of flexibility and compliance models. (M)
12. Dynamics analysis of space missions and docking for spacecraft

Ph.D., Antoni Kopyt
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Simulation of control system operation, selected channel (E,M)

Ph.D., Sebastian Topczewski
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Ph.D., Maciej Zasuwa

The field of aeronautical systems

1. Simulation of the selected control system (channel) algorithms (E,M)
2. Simulation of the selected aeronautical system algorithms (e.g. GPS/INS, GPWS, TCAS, VOR, etc.) (P)

The field of unmanned aerial vehicles

1. Obstacle avoidance (sense and avoid) system for UAV/UGV (E,M)
2. Application of machine learning methods on board UAVs (P,E,M)
3. Other topics on UAVs proposed by students (P,E,M)

The field of modeling and simulation

1. Concept and software development for flight simulator dynamics module (E,M)
2. Concept and software development for selected aeronautical system for flight simulator (E,M)
3. Concept and software development for autopilot in selected channel for flight simulator (E,M)
4. Implementation of open source graphics engine for DAAS simulator (E,M)
5. Concept and software development for object interactions (collisions) for flight simulator (E,M)
6. Pilot training issues in simualator with VR/AR equipment (E,M)
7. Other topics related to flight simulators proposed by students (P,E,M)

Simulations can be carried out in Matlab/Simulink or on the simulators of the Division of Automation and Aeronautical Systems: SW-4, Boeing 737 (C/C++).

M.Sc. Eng., Janusz Gajda
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M.Sc. Eng., Assistant Lecturer Mateusz Sochacki

Themes of intermediate projects

1. orbital mechanics
2. modelling and simulation of spacecraft flight
3. orbital manoeuvres
4. space mission analysis and design
5. spacecraft navigation in near-Earth, interplanetary and interstellar space
6. spacecraft subsystems modelling
7. modelling of the loads acting on a spacecraft
8. optimisation
9. paragliding

Examples of intermediate projects

1. simulation of spacecraft launch
2. simulation of spacecraft landing/deorbitation
3. simulation of atmospheric re-entry/aerocapture with dynamic pressure/temperature limit constraints
4. simulation of satellite constellations, visibility determination of GNSS satellites (GPS, Galileo, GLONASS, Beidou)
5. spacecraft launch/landing trajectory optimisation, Goddard problem
6. spacecraft aerodynamic coefficients determination (free molecular flow)
7. spacecraft reflectivity characteristics coefficients determination (solar radiation pressure)
8. analysis of distribution of objects in near-Earth space based on TLE data
9. spacecraft orbit determination based on ground-based observations
10. International Space Station (ISS) orbit determination based on the photo of its flyover
11. modelling of nonuniform objects' gravity field (spherical harmonics model, mascons model, polyhedral model)
12. Earth's shadow modelling
13. modelling of a star tracker device - camera attitude determination based on an image of the stars
14. multistage rocket optimisation
15. development of a numerical model of a craters covered surface for the simulation of visual navigation during landing
16. interplanetary trajectory optimisation, gravity assists
17. comparison of interplanetary spaceflight simulation with the patched-conics method
18. comparison of low and high thrust manoeuvres (orbit radius change, plane change)
19. simulation of an interplanetary mission propelled by a solar sail
20. simulation of debris dispersion during spacecraft collision
21. development of a tool for rapid/preliminary optimisation of generic functions based on finite list of query points
22. development of an algorithm for generating random attitude with uniform distribution
23. periodic multivariate function interpolation using spherical harmonics
24. paraglider/glider winch/tow launch simulation