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SKY TRONIC

SkyNav

Advanced Autopilot for Unstable Payloads

Bogusław Szlachetko

Ph.D., D.Sc.

Sky Tronic spin-off form
Worcław University of Science and Technology
Faculty of Electronics Photonics and Microsystems Wroclaw, Poland

Scale.PL Top1000 Innovators of Poland in Silicon Valey, 9-12 December 2025

unite! University Network for Innovation, Technology and Engineering

HR EXCELLENCE IN RESEARCH

Evaluated by IEP INSTITUTIONAL EVALUATION PROGRAMME www.iep-qaa.org

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Problem & Solution

Problem:

- Solving the stability challenge for liquids and slung loads.
- The chalenge – unstable payload dynamics

The Solution – **SkyNav**

- Advanced Fuzzy Logic autopilot (HW & SW)
- Advanced algorithm mimics an expert human pilot
- Proper reaction to random changes in dynamic conditions

The undertaking is funded by

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Team

The Team:

- Michal Lower, Ph.D. - Fuzzy Logic control expert
- Boguslaw Szlachetko, Ph.D., D.Sc. - Sensor Data Fusion and a Signal Processing expert

On board:

- embedded RTOS developer
- electronics engineer
- mechanical engineer

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Details

- Standard drone flight dynamics are based on:
  - a fixed Center of Gravity (CoG),
  - IMU (sensors) should be placed as close as possible to CoG.
- Fluid movement (sloshing) inside tanks causes unpredictable kinetic energy transfer.
- Cargo on cables acts as a chaotic pendulum, introducing independent swing forces.
- These factors introduce random, non-linear disturbances that destabilize the aircraft.

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Details

Hardware:

- microcontroler STM32 Coretex M7 arhitecture
- InvenSense ICM20948: 3D gyroscope, accelerometer, magnetometer
- interfaces: RPi connector, 5xUART, 2xI2C, 2xSPI, USB, PPM/SBUS, CAN(optional)
- 8 motors/servos outputs

Software:

- original, Fuzzy Logic-based, stabilisation algorithm
- FreeRTOS
- MAVLINK protocol
- QGroundControl/ArduPilot compatible
- manual, semi-automatic, mission modes

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Hoverbike

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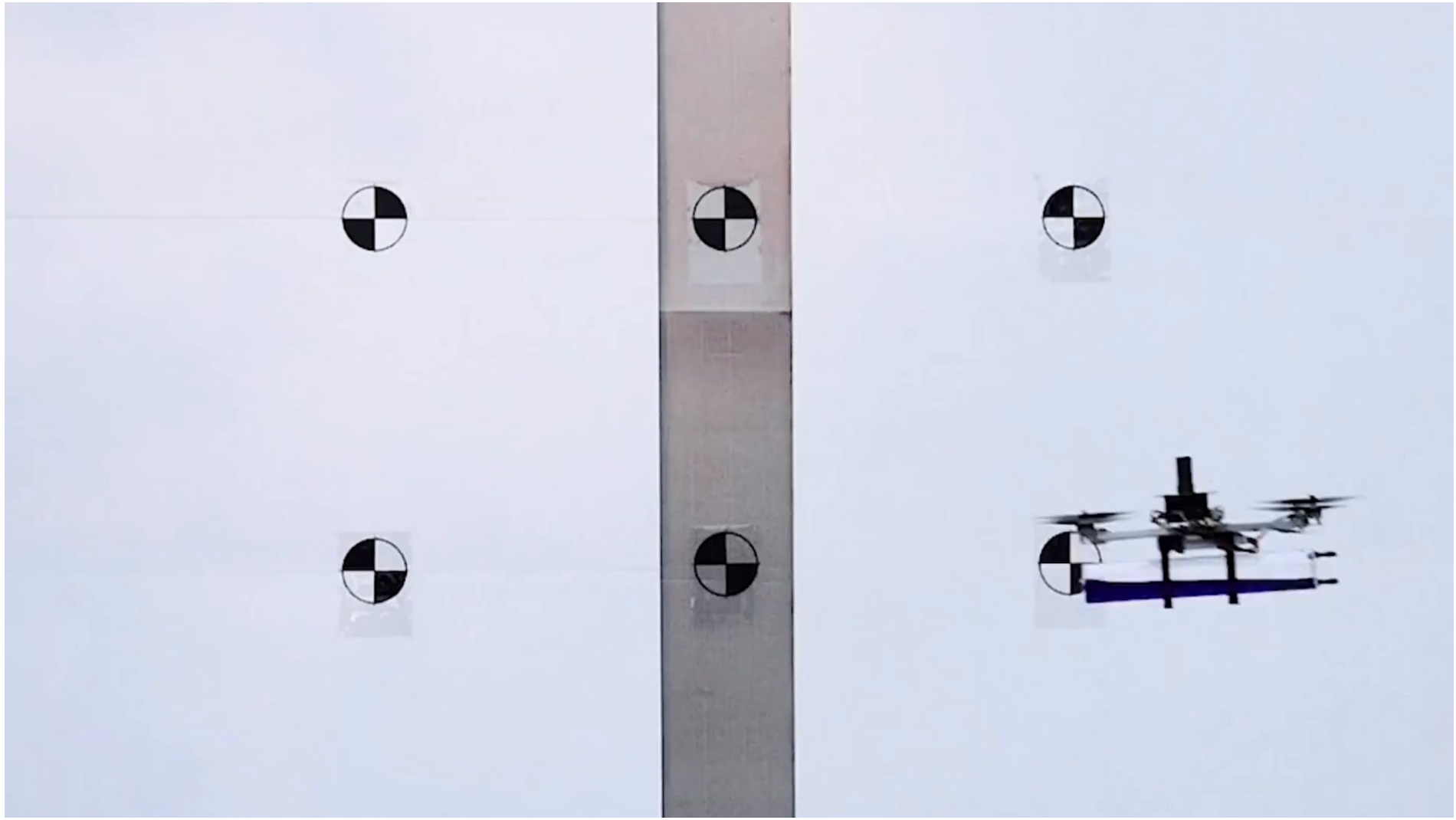
Multirotor



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Market

SkyNav:

- Is innovative
- Direct competitor does not exist

Other solutions:

- Open source PID-based autopilots: ArduPilot/PX4
- DJI - closed source, also PID
- Academic projects:
  - Several papers from China and Turkey
  - AI/Deep Learning based project Neural-Fly
  - https://github.com/aerorobotics/neural-fly
  - AI is a "black-box" solution, and the learning procedure is complicated
  - FLC is a "white-box" solution - rules are based on expert knowledge

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Competitive Landscape

Feature	SkyNav *Sky Tronic*	Standard Autopilot *ArduCopter/PX4*	High-End *Embention/MicroPilot*
Control Logic	Fuzzy Logic (*Human-like)*	Rigid PID *(Linear)*	Adaptive PID Robust Control
Reaction to chaos	Anticipates	Reacts with Latency	Needs Complex Tuning
Liquid Sloshing	High Stability	Risk of Oscillation	Moderate *(if tuned well)*
Setup Complexity	Low *(Rule-based)*	High *(Requires precise math model)*	Very High *(Engineer required)*
Cost Efficiency	Low *(Cheap HW)*	High *(Cheap HW)*	Low *(Very Expensive HW&SW)*

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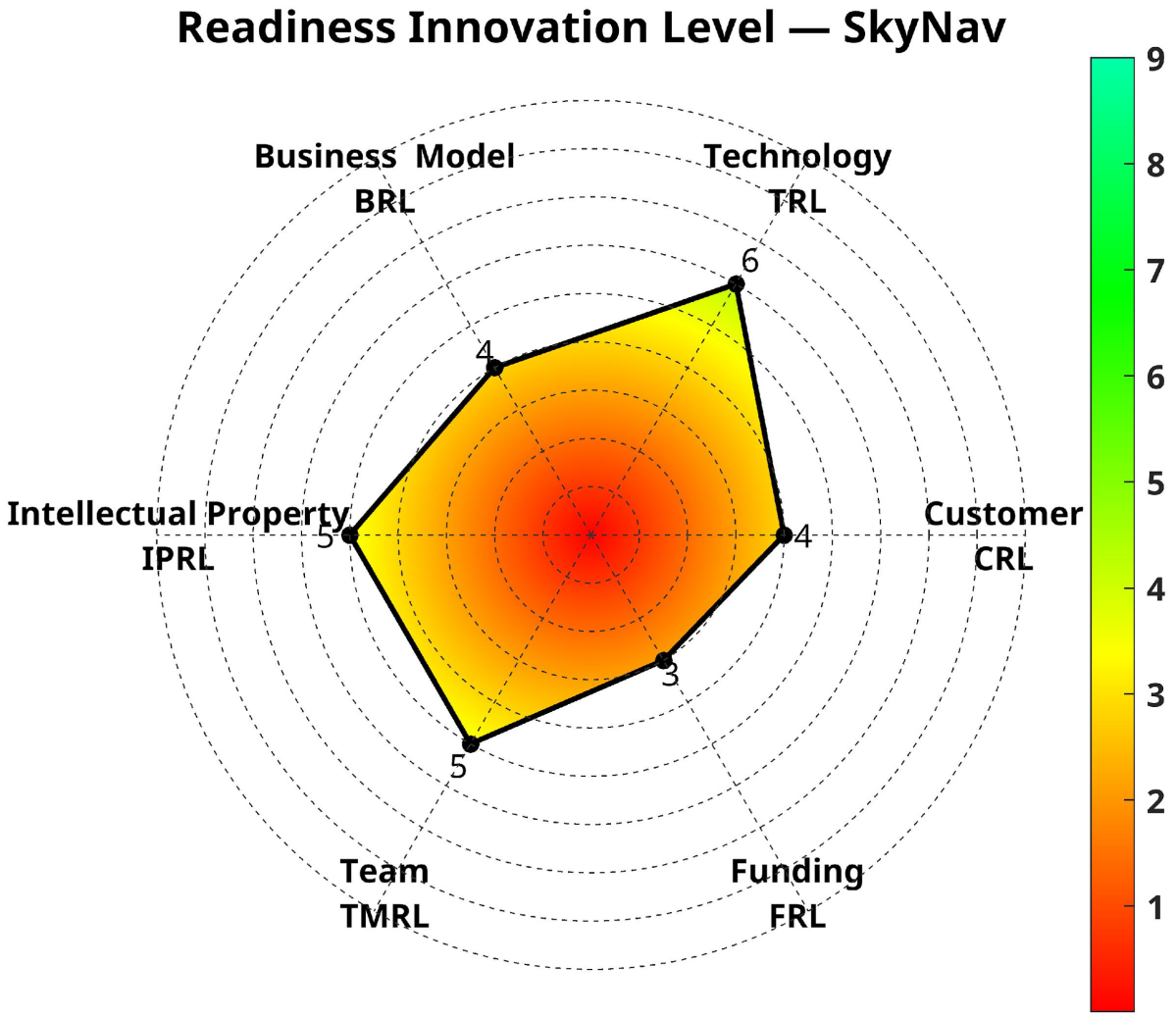
Readiness



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Keywords

- Fuzzy Logic Controller - FLC
- UAV Autopilot
- Unstable Payloads
- Flight Stabilization
- Aerial Robotics

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The Roadmap

Seed funding - $500k:

- To develop a precision crop-spraying drone

Other plans:

- New version of the HW - two IMUs
- Improvement in state estimator through data fusion of new sensors (e.g., optical flow)

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