Pavel Petráček

Czech Technical University In Prague
Department of Cybernetics
Multi-Robot Systems & Fly4Future
✉ *petracekpav@gmail.com*
+420 739 757 519
mrs.felk.cvut.cz/pavel-petracek
GitHub *Google Scholar*

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Personal information

Nationality	Czech
Date of birth	November 26, 1994
Languages	Czech (native speaker), English

Education

2019–2024 **PhD in Mobile Robotics,** Department of Cybernetics, Faculty of Electrical Engineering, Czech Technical University in Prague (FEE CTU)
— **dissertation**: Robust UAV localization in perception-degraded environments (pdf)
— **supervisor**: doc. Ing. Martin Saska, Dr. rer. nat.
— **publication count** since 2019: 14 impacted journals, 3 conference proceedings
— **h-index**: 8 in WoS, 14 in Google Scholar, **citations count**: 170+ in WoS, 580+ in Google Scholar

2017–2019 **Engineer in Cybernetics and Robotics,** FEE CTU

2014–2017 **Bachelor in Cybernetics and Robotics,** FEE CTU

Experience: Academia

2019–present **Researcher at Multi-Robot Systems laboratory,** FEE CTU
— **research:** resilient autonomy of aerial robots in real-world settings | distributed multi-robot coordination
— **experience:** co-development of the MRS UAV System (Github) | research applied in real practice (heritage preservation, speleology, search & rescue, firefighting) | robotic experiments and competitions | demos for investors, industrial partners, students, and media | student supervision | project management | field popularization | academic teaching | events organization (summer schools and workshops)

Research projects & robotic competitions

2020–2022 **DARPA Subterranean Challenge (web):** Exploring unknown subterranean environments with a cooperative team of ground and aerial autonomous robots
— **contributions:** novel methods of onboard perception, localization, and mapping of UAVs in perception-degraded environments | UAV system design | real-time systems integration | system evaluation and testing | key member for in situ deployment of aerial robots

2018–2022 **Dronument (video):** Documenting interiors of historical structures with autonomous aerial teams
— **contributions:** reliable **autonomous UAV team cooperating in interiors of historical structures** | robustness to geometrical symmetricity and other perceptual degradation | direct use in heritage preservation: deployed for documenting 18 historical objects (including 2 UNESCO sites)

2017-2024 **Swarming (video):** Decentralizing communication-less control of UAVs among obstacles
— **contributions:** novel bio-inspired algorithms for communication-less perception-aware coordination of UAV teams in obstacle-filled environments

2020–2024 **DOFEC (video):** Extinguishing fires in aboveground floors using an autonomous UAV
— **contributions:** detection and localization of fires from on-board sensors | mission planning

International stays

2023 **Autonomous Robots Lab at NTNU:** 2 months research stay, cooperation on doctoral topic with prof. Kostas Alexis

2017 **Aerospace Information Technology at University of Würzburg, Germany:** summer school

Experience: Industry

2023–present **Fly4Future s.r.o.:** R&D projects lead

Utilizing my field experience in transferring state-of-the-art research in aerial robotics to industry

- [2024–present, grant TAČR Trend] Innovating autonomous interior inspection in project INDAIR

2016-2017 **CertiCon a.s.:** learned how to properly think about and write automated software tests | gained experience in corporate project management and scheduling

2012-2014 **KD planeta s.r.o.:** first-hand experience with robotic automation — interaction between human operators, robotic manipulators, and CNC machinery

Honors & awards

2022 **Methodology M17+:** excellent international evaluation of our Dronument solution (link)

2021 **DARPA Subterranean Challenge:** team CTU-CRAS-NORLAB competing with international universities and companies (e.g., Caltech, MIT, ETH Zürich) in multi-robot search & rescue operations in underground environments

— 1st place among non-funded teams in the Urban Circuit, real-world deployment ($500k)
— 2nd place among all teams in the Final Round, virtual deployment ($500k)

2019 **Dean's price for astounding Master thesis at FEE CTU**

— **topic:** Design, localization and position control of a specialized UAV platform for documentation of historical monuments

2017 **Dean's price for astounding Bachelor thesis at FEE CTU**

— **topic:** Decentralized model of a swarm behavior Boids in ROS

Academic activities

Teaching
- Algorithms and Programming: Python and basic programming algorithms for Bachelor students
- Multi-Robot Aerial Systems: for Master students, author of UAV swarming task #3

Workshops
- Seminar tasks introduction, *In IEEE RAS Summer School on Multi-Robot Systems*, 2022.
- Dronument workshop (organizer and speaker), *hosted at FEE CTU*, 2021.
- Importance Sampling: Degradation-Aware Alternative to Voxelization in Robot Pose Estimation, *In IEEE IROS IPPC **and** ROPEM workshops*, 2023.
- Cooperative UAV Autonomy of Dronument: New Era in Cultural Heritage Preservation, *In IEEE IROS IPPC workshop*, 2023.
- Decentralized Aerial Swarms Using Vision-Based Mutual Localization, *In IEEE IROS (Workshop on Integrated Perception, Planning, and Control for Physically and Contextually-Aware Robot Autonomy)*, 2018.

Conference committee
- Co-chair of session *Micro and Mini UAS I* at ICUAS'22 (chair: prof. Subodh Bhandari).

Reviewer for journals and conferences

- Transactions on Cybernetics
- Transactions on Robotics (T-RO)
- Transactions on Field Robotics (T-FR)
- Robotics and Automation Letters (RA-L)
- International Conference on Robotics and Automation (ICRA)
- International Conference on Intelligent Robots and Systems (IROS)

Supervised students

Ing. **Vojtěch Nydrle,** Cybernetics and robotics, FEE CTU
— thesis: Extinguishing of indoor fires by an autonomous UAV

Martin Fischer, Cybernetics and robotics, FEE CTU
— thesis: Matching of multimodal features

Bc. **Vojtěch Nydrle,** Cybernetics and robotics, FEE CTU
— thesis: Design of a specialized UAV platform for the discharge of a fire extinguishing capsule (Dean's price for astounding Bachelor thesis)

Martin Fischer, Cybernetics and robotics, FEE CTU
— thesis: Lidar and multi-camera calibration and fusion (Dean's price for astounding Bachelor thesis)

Azat Mukhametshin, Open informatics, FEE CTU
— thesis: World management and coverage path planning in the MRS UAV System

Peer-reviewed publications

Journal articles

- **P. Petracek**, V. Kratky, and M. Saska, "Dronument: System for Reliable Deployment of Micro Aerial Vehicles in Dark Areas of Large Historical Monuments," *IEEE RA-L*, vol. 5, no. 2, pp. 2078–2085, Apr. 2020.
- **P. Petracek**, V. Walter, T. Baca, and M. Saska, "Bio-Inspired Compact Swarms of Unmanned Aerial Vehicles without Communication and External Localization," *Bioinspiration & Biomimetics*, vol. 16, no. 2, p. 026 009, Mar. 2021.
- **P. Petracek**, V. Kratky, M. Petrlik, T. Baca, R. Kratochvil, and M. Saska, "Large-Scale Exploration of Cave Environments by Unmanned Aerial Vehicles," *IEEE RA-L*, vol. 6, no. 4, pp. 7596–7603, Oct. 2021.
- **P. Petracek**, V. Kratky, T. Baca, M. Petrlik, and M. Saska, "New Era in Cultural Heritage Preservation: Cooperative Aerial Autonomy for Fast Digitalization of Difficult-to-Access Interiors of Historical Monuments," *IEEE Robotics & Automation Magazine*, pp. 2–19, 2023.
- **P. Petracek**, K. Alexis, and M. Saska, "RMS: Redundancy-Minimizing Point Cloud Sampling for Real-Time Pose Estimation," *IEEE Robotics and Automation Letters*, vol. 9, no. 6, pp. 5230–5237, 2024.
- V. Kratky, **P. Petracek**, V. Spurny, and M. Saska, "Autonomous Reflectance Transformation Imaging by a Team of Unmanned Aerial Vehicles," *IEEE RA-L*, vol. 5, no. 2, pp. 2302–2309, Apr. 2020.
- V. Kratky, **P. Petracek**, T. Baca, and M. Saska, "An Autonomous Unmanned Aerial Vehicle System for Fast Exploration of Large Complex Indoor Environments," *Journal of Field Robotics*, vol. 38, no. 8, pp. 1036–1058, Dec. 2021.
- V. Kratky, **P. Petracek**, T. Nascimento, M. Cadilova, M. Skobrtal, P. Stoudek, and M. Saska, "Safe Documentation of Historical Monuments by an Autonomous Unmanned Aerial Vehicle," *JGI*, vol. 10, no. 11, p. 738, Oct. 2021.
- M. Petrlik, **P. Petracek**, V. Kratky, T. Musil, Y. Stasinchuk, M. Vrba, T. Baca, D. Hert, M. Pecka, T. Svoboda, and M. Saska, "UAVs Beneath the Surface: Cooperative Autonomy for Subterranean Search and Rescue in DARPA SubT," *Field Robotics*, vol. 3, no. 1, pp. 1–68, Jan. 2023.
- D. Hert, T. Baca, **P. Petracek**, V. Kratky, R. Penicka, V. Spurny, M. Petrlik, M. Vrba, D. Zaitlik, P. Stoudek, V. Walter, P. Stepan, J. Horyna, V. Pritzl, M. Sramek, A. Ahmad, G. Silano, D. B. Licea, P. Stibinger, T. Nascimento, and M. Saska, "MRS Drone: A Modular Platform for Real-World Deployment of Aerial Multi-Robot Systems," *Journal of Intelligent & Robotic Systems*, vol. 108, no. 4, p. 64, Jul. 2023.
- F. Novak, V. Walter, **P. Petracek**, T. Baca, and M. Saska, "Fast Collective Evasion in Self-Localized Swarms of Unmanned Aerial Vehicles," *Bioinspiration & Biomimetics*, vol. 16, no. 6, p. 066 025, Nov. 2021.

- K. Ebadi, L. Bernreiter, H. Biggie, G. Catt, Y. Chang, A. Chatterjee, C. E. Denniston, S.-P. Deschenes, K. Harlow, S. Khattak, L. Nogueira, M. Palieri, **P. Petracek**, M. Petrlik, A. Reinke, V. Kratky, S. Zhao, A.-a. Agha-mohammadi, K. Alexis, C. Heckman, K. Khosoussi, N. Kottege, B. Morrell, M. Hutter, F. Pauling, F. c. Pomerleau, M. Saska, S. Scherer, R. Siegwart, J. L. Williams, and L. Carlone, "Present and Future of SLAM in Extreme Underground Environments," 2022.
- T. Manoni, D. Albani, J. Horyna, **P. Petracek**, M. Saska, and E. Ferrante, "Adaptive Arbitration of Aerial Swarm Interactions through a Gaussian Kernel for Coherent Group Motion," *Frontiers in Robotics and AI*, vol. 9, 2022.
- T. Roucek, M. Pecka, P. Cizek, T. Petricek, J. Bayer, V. Salansky, T. Azayev, D. Hert, M. Petrlik, T. Baca, V. Spurny, V. Kratky, **P. Petracek**, D. Baril, M. Vaidis, V. Kubelka, F. Pomerleau, J. Faigl, K. Zimmermann, M. Saska, T. Svoboda, and T. Krajnik, "System for Multi-Robotic Exploration of Underground Environments CTU-CRAS-NORLAB in the DARPA Subterranean Challenge," *Field Robotics*, vol. 2, pp. 1779–1818, 2022.

Conference articles

- A. Ahmad, V. Walter, **P. Petracek**, M. Petrlik, T. Baca, D. Zaitlik, and M. Saska, "Autonomous Aerial Swarming in GNSS-denied Environments with High Obstacle Density," in *IEEE ICRA*, May 2021, pp. 570–576.
- T. Amorim, T. Nascimento, **P. Petracek**, G. de Masi, E. Ferrante, and M. Saska, "Self-Organized UAV Flocking Based on Proximal Control," in *ICUAS*, Jun. 2021, pp. 1374–1382.
- D. Hert, T. Baca, **P. Petracek**, V. Kratky, V. Spurny, M. Petrlik, M. Vrba, D. Zaitlik, P. Stoudek, V. Walter, P. Stepan, J. Horyna, V. Pritzl, G. Silano, D. Bonilla Licea, P. Stibinger, R. Penicka, T. Nascimento, and M. Saska, "MRS Modular UAV Hardware Platforms for Supporting Research in Real-World Outdoor and Indoor Environments," in *ICUAS*, Jun. 2022, pp. 1264–1273.