Research of groups of aerial robots at CTU in Prague



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Multi-Robot Systems at CTU in Prague

30 employees + >30 MSc. & Bc. Students

and >30 AUTONOMOUS DRONES











MRS group in years

2015 – 3 employees

2016 – 5 employees

2017 – 8 employees

2018 – 12 employees

2019 – 16 employees

2020 – 22 employees

2021 – 30 employees

2022 – >40 employees - HIRING



3/2017 – MBZIRC 3rd challenge:
1st place $330.000



2/2020 – MBZIRC 2rd challenge:
1st place $250.000, TOTAL WINNERS



2019-2021 - DARPA SubT: 2x 1st place among self-funded teams. 2nd place in virtual ch. finals $200k & $500k & $500k

FLY4FUTURE

Forming the future of unmanned flights

Development and prototyping of autonomous aerial systems

Customized platforms for areal research and development

R&D projects



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- Close collaboration with MRS group at CTU in Prague
- 15 R&D engineers for technology transfer from research to products
- 4 new positions starting 11/2022

FLY4FUTURE

Technology transfer from MRS research to products

DEVELOPMENT AND PROTOTYPING OF AUTONOMOUS AERIAL SYSTEMS







CUSTOMIZED PLATFORMS FOR UAV RESEARCH AND DEVELOPMENT







R&D PROJECTS – APPLICATION FOR FUNDING, PROJECT MANAGEMENT







Complete chain of development of AI smart drone solutions: basic research → application R&D → product realization and deployment

- TRL 1 – Basic principles
- TRL 2 – Technology concept
- TRL 3 – Experimental proof of concept
- TRL 4 – Technology validated in lab
- TRL 5 – Technology validated in relevant environment
- TRL 6 – Technology demonstrated in relevant environment
- TRL 7 – System prototype demonstration in operational environment
- TRL 8 – System complete and qualified
- TRL 9 – Actual system proven in operational environment (manufacturing)



Basic/fundamental research

>30 researchers from MRS at CTU

>80 researchers from CRAS at CTU

Application oriented R&D

> 10 engineers from MRS at CTU

> 15 engineers from F4F s.r.o.

> 20 engineers from CRAS at CTU

Final product realization and deployment

> 15 engineers from F4F s.r.o.

> 10 positions can be open and filled

Long-term motivation: Swarms of micro aerial vehicles in wild

- Swarming in GNSS denied space without direct communication
- Strictly decentralized system in unknown environment
- Scalable: large groups
- High density of obstacles

Petracek Bioinspiration & Biomimetics 2020, Ahmad ICRA 2021, Krizek ICUAS 2022, Saska ISRR 2017, Saska AURO 2017, Brandtner ECMR 2017, Saska JINT 2016, Saska ICUAS 2015, Saska ICRA 2014, Saska IJRR 2014



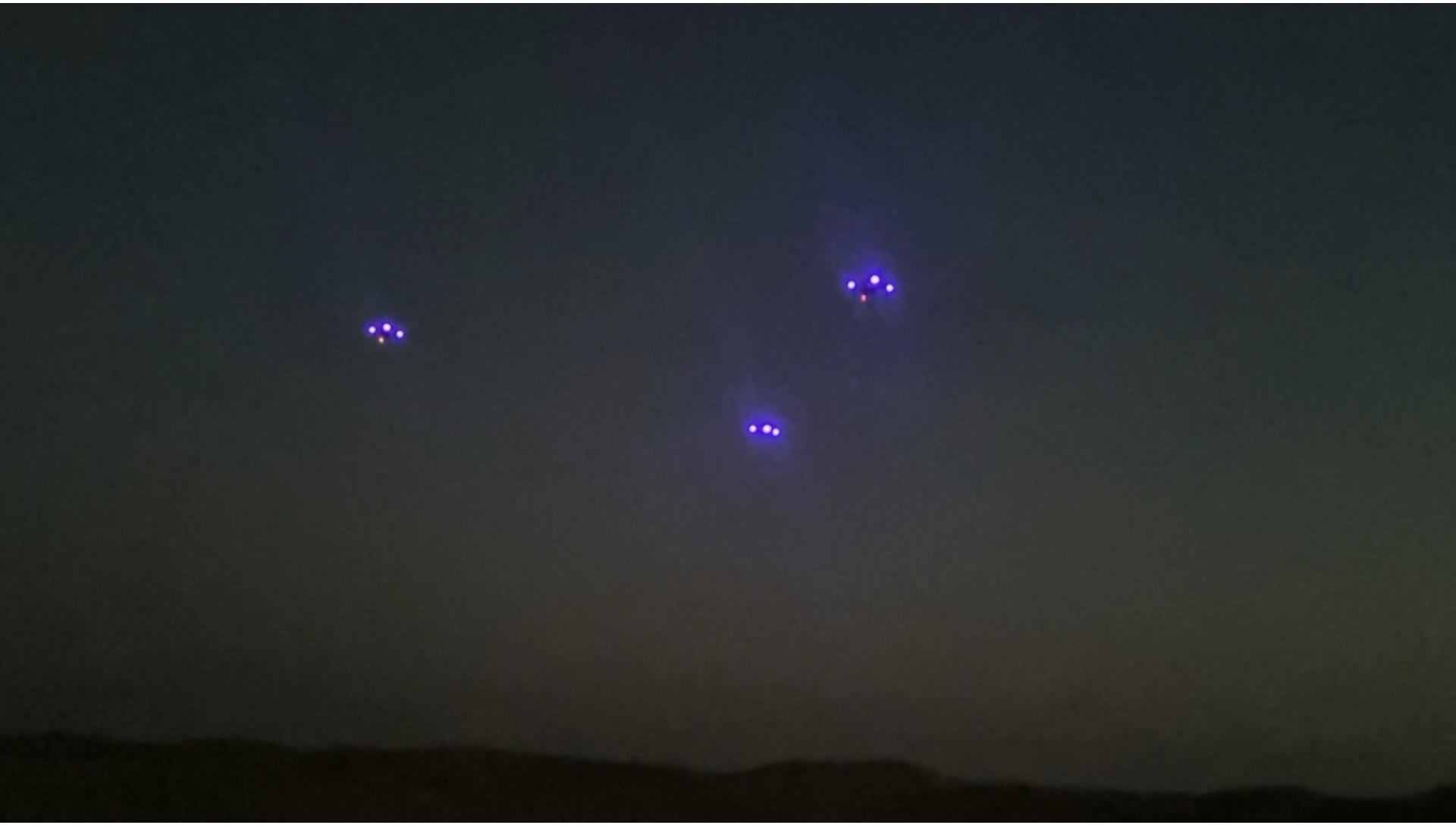
Nature-inspired swarming in environments with obstacles

- No GNSS, no communication, fully decentralized



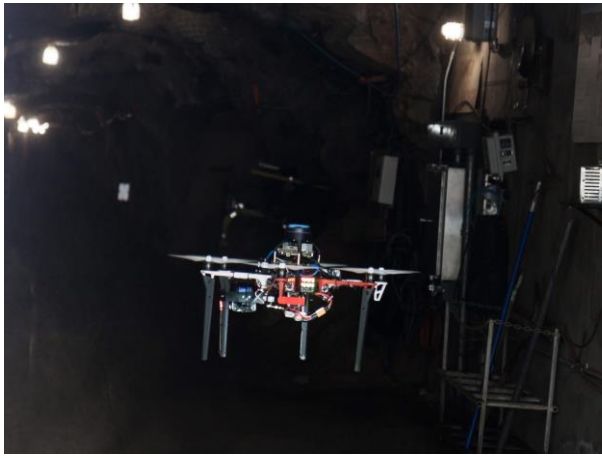
Nature-inspired swarming in environments with obstacles

- Fast flying, independent to light conditions



DARPA Subterranean Challenge - Tunnel Circuit

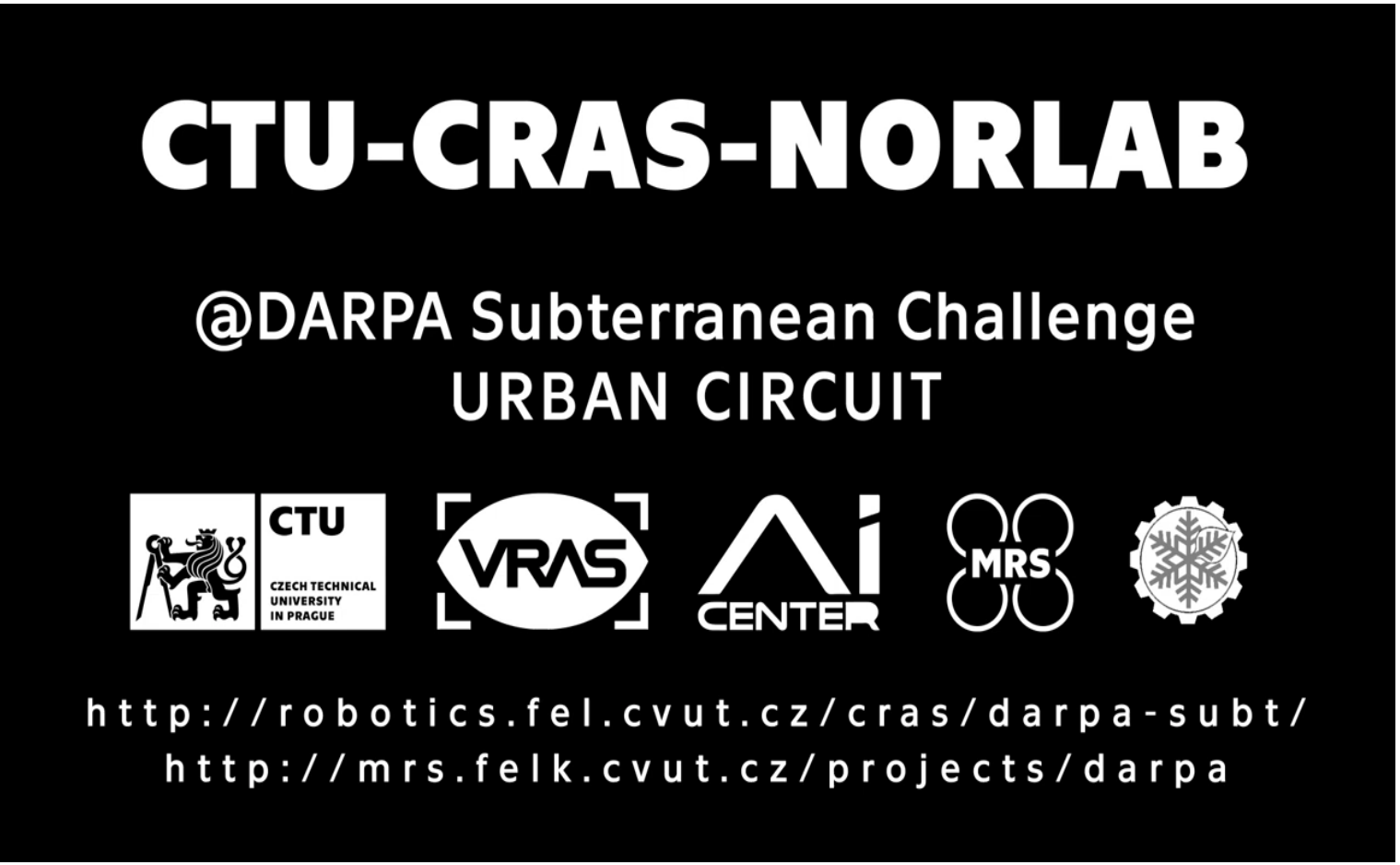
- Multi-robot team designed for exploration of underground environment
- DARPA SubT Tunnel Circuit - 8/2019: 1st place among self-funded teams, 3rd place in total. $200 000 prize

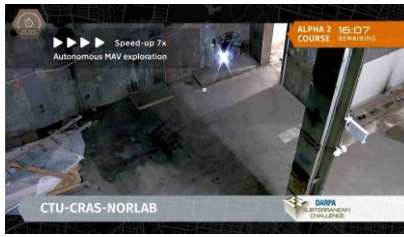




DARPA Subterranean Challenge - Urban Circuit

- Multi-robot team exploring underground urban environment
- DARPA SubT Urban Circuit - 2/2020: 1st place among self-funded teams, 3rd place in total. $500 000 prize





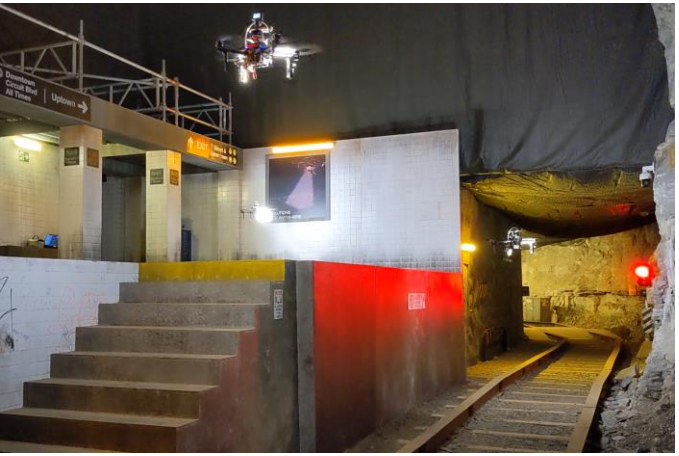






DARPA Subterranean Challenge – Final Event

- A combination of Cave, Urban, and Tunnel Circuits. Virtual and system tracks
- DARPA SubT Final Event - 9/2021: 2nd place in the virtual track. $500 000 prize. 6 best teams were using MRS-CTU X500 platform in the virtual track.














CTU-CRAS-NORLAB
[3] Active Robots
Time Remaining
35:38
Artifact Distance
48.5 m
Score
0
Attempts
0 /40
Current Speed
1.59 m/s
Glyph
World 01
Artifacts
Rockfalls
Robots
Active Robot

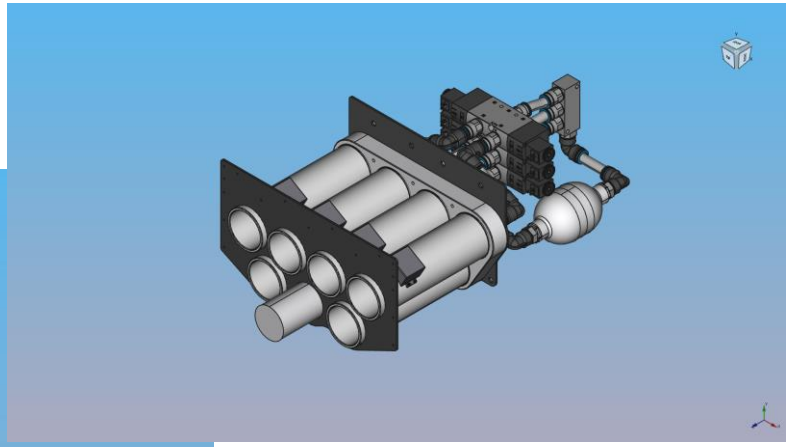


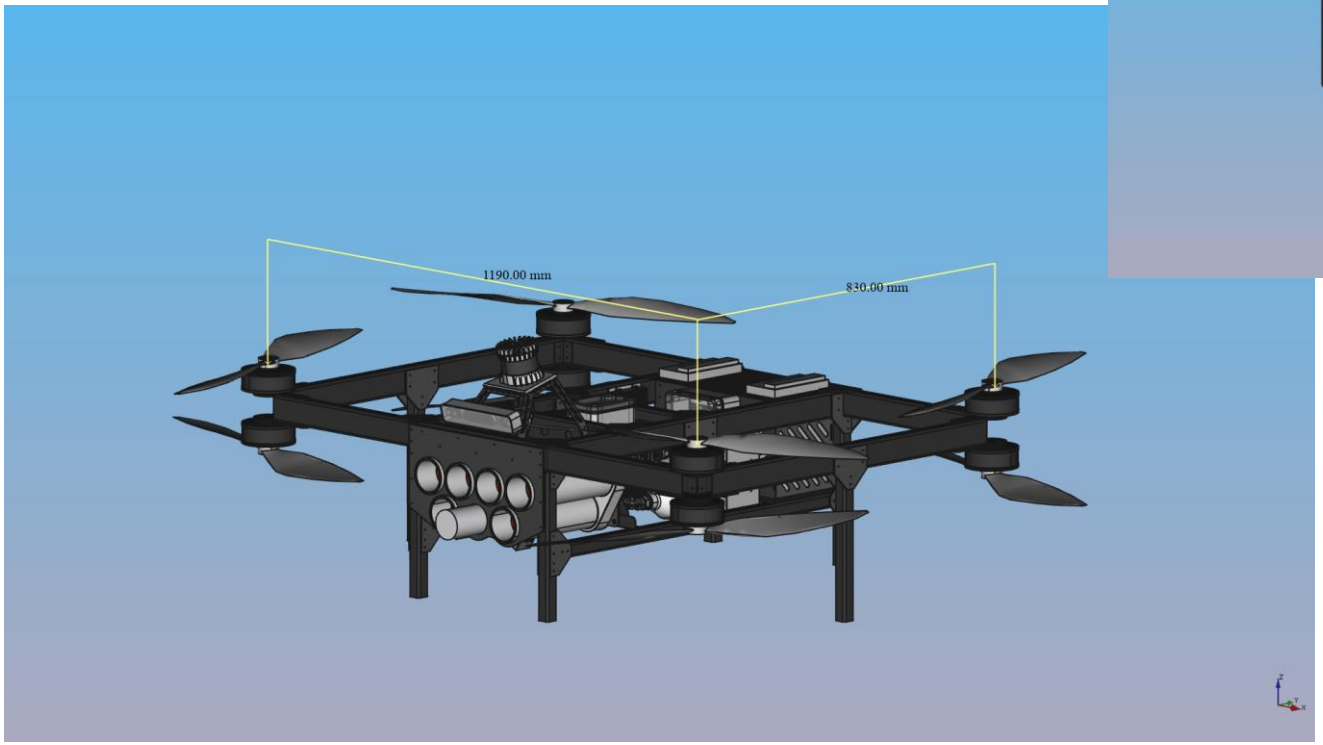


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DOFEC: Discharging Of Fire Extinguishing Capsules

- Full scale platform with 25kg payload
- 6 firefighting Bonpet liquid grenades + 1 window-piercing metal grenade









FACULTY
OF ELECTRICAL
ENGINEERING
CTU IN PRAGUE

Localization of sources of ionizing radiation

- Group of small UAVSwith onboard Compton camera detectors
- Static or moving gamma radiation source

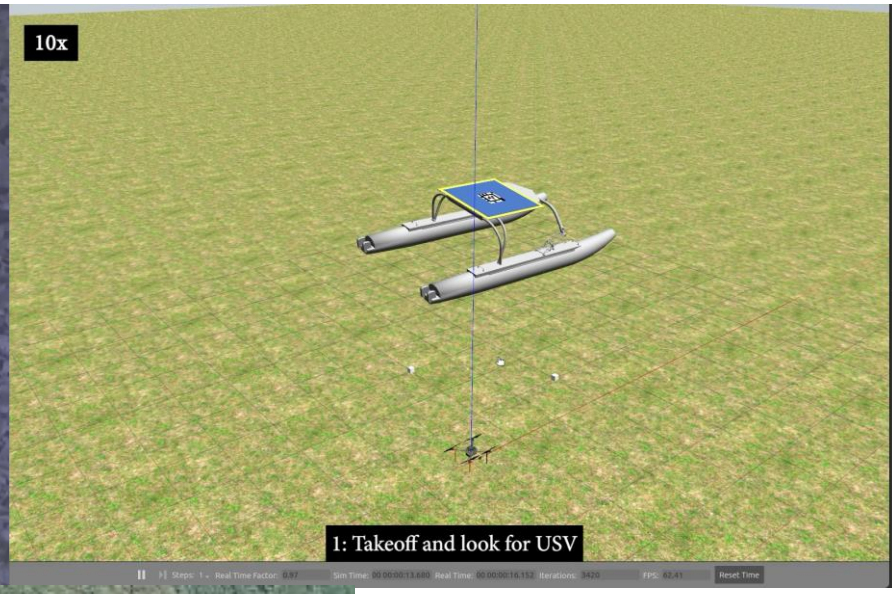




Teams of Cooperating UAVs and autonomous boats (USVs)

- Marine operations: cargo delivering to ships, autonomous monitoring and surveillance (on the surface and under water), inspection of ships, water surface monitoring and cleaning





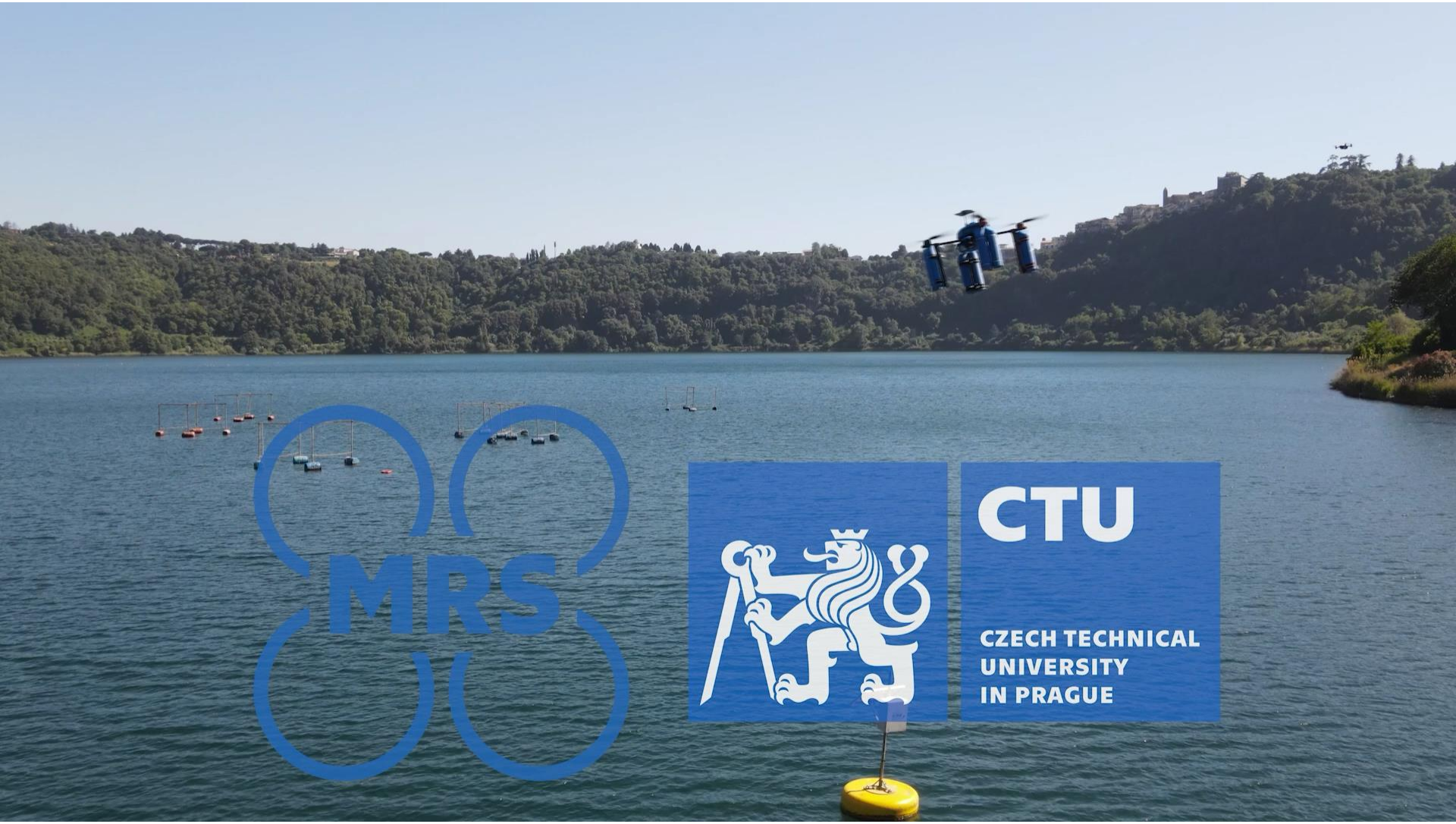


Teams of Cooperating UAVs and autonomous boats (USVs)

- Grasping of light objects from water and pulling the heavy one towards USVs
- Estimation of weight of rope-suspended payload
- Force control with waves, water streams, and wind disturbances



Safe UAV landing on undulating USVs in waves and wind



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Thank you for your attention



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