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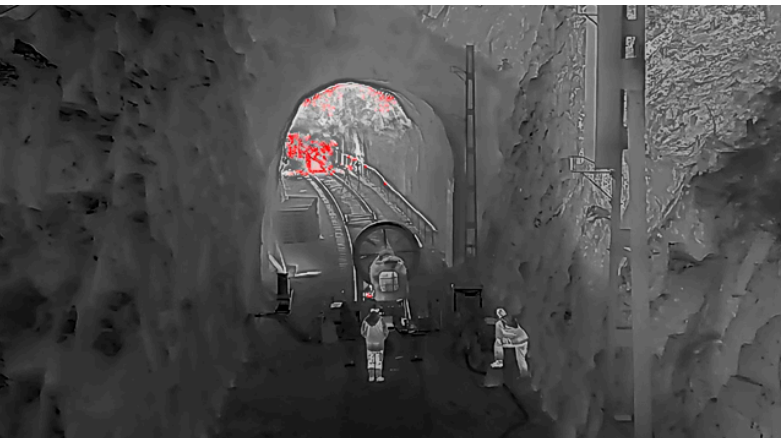
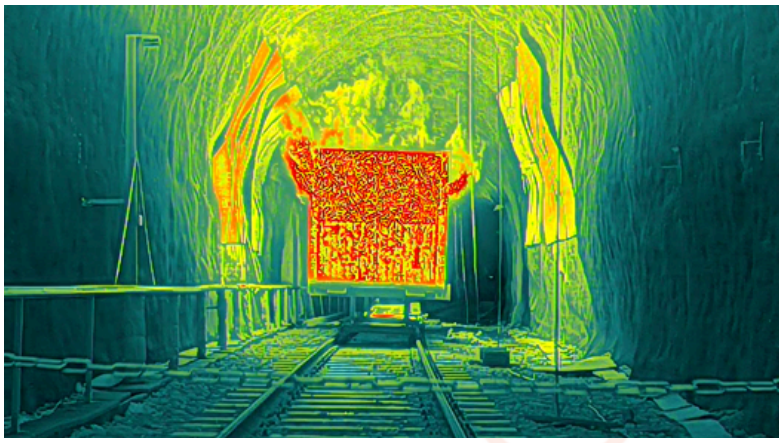
DRONE USE CASES





Drones in Indoor Missions

Besides outdoor missions, drones are more and more utilized indoors, especially for measurement and inspection activities in physically cramped and constricted GNSS-denied spaces. In these dangerous conditions, drones can help to capture data without risking human lives.
This drone use case looks at two ongoing R&D projects: One is run in Sweden by the Fire & Rescue Service Södertörns Brandförsvarsförbund cooperating with other departments and the Swedish Civil Contingencies Agency in setting up test sites. The other one is run in Austria and led by the TU Graz Volunteer Fire Brigade in collaboration with TU Graz (Graz University of Technology). Both projects assist civil protection mechanisms and agencies through their R&D and educational activities.

What is it, where and how is it used?

The Swedish project aims to find out if and how drone missions can be conducted in GNSS denied environments like tunnels, garages, indoors etc. The Austrian project explores indoor reconnaissance and USAR (Unmanned Search and Rescue) activities including indoor radiation detection to demonstrate the capability of measuring radiation inside buildings with FPV (First Person View)-drones.
The main objectives of the projects are to use UAS to monitor hard-to-reach locations and to use UAS agility to speed up the monitoring process, making the response to incidents in these places not only faster but also more efficient and safer for the personnel involved.

Technical and organisational aspects

The goal of the tests conducted within the projects is to confirm whether the equipment is suitable for indoor tasks, to identify its technical limits, and to gather information so that training and operational procedures can be further developed.
The Swedish project uses the DJI Matrice 4TD with an obstacle avoidance module consisting of av LiDAR and radar whereas the Austrian project uses the DJI Avata 1 & 2 as well as a Radiacode 102 Scintillation Gamma-Detector. The UAV platforms have multiple systems for automatically avoiding physical objects in flight paths. Vision sensors and - in low light conditions - LiDAR are used. The image from the UAV streamed in real time and communication is conducted mainly through radio or telephone. At this point, data is not analyzed as the focus is on testing the flights.

Funded by the European Union

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Benefits and effectiveness

It has already been observed that there is great potential in these indoor missions. In one setup, 200 m of a smoke-filled train tunnel could be searched in just seconds. This shows that these missions can help to improve situational awareness in hazardous environments quickly by using technology instead of deploying personnel. Compared with traditional methods, these solutions are much faster and safer in case of radiological contamination and other dangerous situations. As these operations take place indoors, they are not subject to aviation regulations. However, GDPR requirements apply if individuals are captured in the recorded audiovisual material.

Key challenges

The main challenges that were identified are the following:

- Loss of Signal (LoS) - GPS loss: Walls, roofs and underground spaces block the satellite signal. The drone cannot determine its precise location and may drift.
- Sensor interference: Altitude sensors may be disrupted by air conditioning (pressure changes), and visual sensors by low or no light.
- Collision risk: Maneuvering space is limited, placing furniture, walls, or people in very close proximity.
- Dynamic obstacle management: In heavy smoke, automatic obstacle avoidance is unreliable and there is no way to read the ambient temperature from the UAV which might be a problem when flying towards a fire. This could result in a damaged UAV or a crash.
- For research purposes the biggest challenge is to find test sites & funding for buying equipment.

Future potential

In order to expand or replicate the solutions in other regions or countries, both projects plan to share their results with other fire, rescue and emergency services. There is strong potential and increasing confidence that indoor drone operations will soon become a standard operational practice.
The use of indoor drones is rapidly shifting from manual remote-piloted flights to fully autonomous, AI-driven types of missions. These can include operations such as:

- Automated warehouse management - to safely navigate warehouse corridors, scan barcodes, and track and count inventory, reducing labour costs and human error,
- Industrial inspections - to safely inspect hazardous, confined spaces like boilers, chimneys, and underground tunnels without putting human workers at risk,
- Security & surveillance - to navigate indoor environments and conduct routine patrols, investigate alarms, and provide live tactical feeds,
- Search & rescue operations - to locate survivors inside collapsed buildings or smoke-filled environments when GPS is completely blocked,
- Cultural mapping - scanning historical buildings and subterranean archaeological sites to create precise 3D digital twins and architectural documentation.

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