# UNEXMIN H2020 project: an autonomous underwater explorer for flooded mines

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**ABSTRACT:**

*UNEXMIN (**Un**derwater **Ex**plorer for Flooded **Min**es, Grant Agreement No. 690008, www.unexmin.eu) is a project funded by the European Commission's HORIZON2020 Framework Programme. The project is developing a multi-platform robotic system for the autonomous exploration and mapping of flooded underground mines. The robotic system – UX-1 – will use non-invasive methods for the 3D mapping of abandoned underground flooded mines, bringing new important geological data that currently cannot be obtained by other means without having significant costs and safety risks.*

*The deployment of a multi-robotic system in a confined and unknown environment poses challenges to the autonomous operation of the robot, and there is a risk of damaging the equipment and the mine itself. Key challenges are related to 1) structural design for robustness and resilience, 2) localization, navigation and 3D mapping, 3) guidance, propulsion and control, 4) autonomous operation and supervision, 5) data processing, interpretation and evaluation.*

*Underwater environments constrain basic robotic functions as well as the size and weight of any operable robot. The limiting factors in these environments influence the type and amount of equipment able to be mounted onto a robotic system. Crucial abilities for an underwater robot's functionality include unobstructed movement, autonomy, mapping and environmental awareness. To enable these critical functions, we employ components such as cameras, SONAR, thrusters, structured-light laser scanners, and on-board computers, rechargeable batteries and protective pressure hulls. In UNEXMIN, additional underwater instrumentation is being developed to measure pH, pressure, temperature, water chemistry and conductivity, magnetic fields, and gamma radiation levels. An on-board geophysical system will enable sub-bottom profiling, and multispectral and UV fluorescence imaging units are being installed for mineralogical identification. All these tailor-made instruments are been tested in laboratory and real environment conditions.*

*The UNEXMIN project is currently ongoing with the construction of the first mechanical UX-1 model as well as setting-up the instrumentation. Component and instrument validations and simulations are being tested to understand the behavior of the technology in the flooded mine environment. In parallel, tools for mine perception, navigation, 3D-mapping and exploration, and post-processing and data analysis are under development. After the groundwork and setup phases, the robot prototype, which is due in the first half of 2018, is going to be tested at four sites under real-life conditions with increasing difficult mission objectives in terms of mine layout, topology and geometry. The test sites include the Kaatiala mine in Finland, the Urgeiriça mine in Portugal and the Idrija mine in Slovenia. The final, most ambitious demonstration is a survey of the entire flooded section of the Ecton underground mine in the UK, which nobody has seen for over 150 years.*