UNEXMIN ROBOTICS AND TECHNOLOGY DEVELOPMENT

A NEW WAY TO EXPLORE, MAP AND OBTAIN SPATIAL INFORMATION FROM FLOODED UNDERGROUND ENVIRONMENTS

TECHNOLOGY
- Autonomous underwater geo-exploration
- 3D Structural mapping
- Geoscientific and spatial data

TARGET GROUPS
- ICT and robotic solutions providers
- Techology developers for mineral exploration

UPDATE

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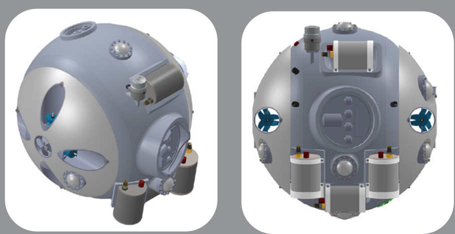
Control of the robot is distributed among three subsystems: propulsion unit, ballast system and pendulum mechanism. The propulsion system with 8 thrusters distributed symmetrically in lateral manifolds enables the robot to move forward or backward, or to tilt left or right. The pitch motion is generated by innovative pendulum mechanism inside the robot. Moreover, the robot is equipped with a ballast system for long distance vertical motion.

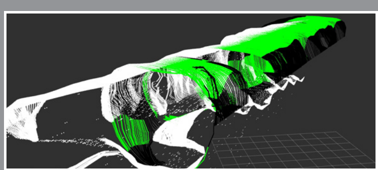


General layout of the UX-1 robot (CAD models)

UX-1 characteristics:
- Shape: spherical
- Size (diameter): 0.6m
- Autonomy: 5 hours
- Max operational depth: 500m
- Operating speed: 1-2 km/h

Post-processing and data analysis tools are being prepared specially for UX-1 to obtain and make interpretations of the recovered mapping and geological data. This data is used to visualize the geometry of the flooded mine openings, by using the four SLS (structured light systems), camera images, sonar multibeam and acoustic imaging data. A unique outcome will come in the form of virtual reality 3D visualizations of the recorded data.

Pre-operational tests will be held in four mines across Europe: Kaatiala (Finland), Urgeiriça (Portugal), Idrija (Slovenia) and Ecton (England). These mines present progressively more complex environments for the UNEXMIN technology. Tests intend to prove that the robot can deliver useful and relevant geo-information from different flooded mine layouts and conditions.



3D SLS (green) and M3 (white) reconstruction that will be used to visualize the flooded mine and other underwater environments.

UX-1 developers

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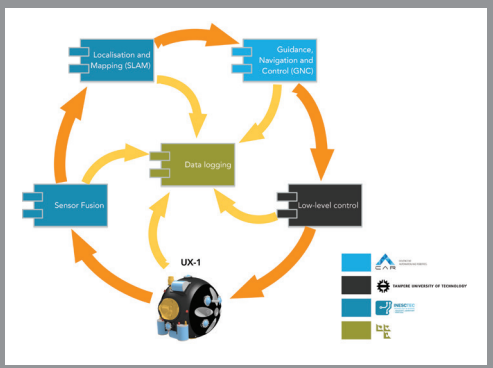
Autonomous Underwater Vehicles (AUVs) have an extensive range of applications in marine science and are increasingly being used in the scientific, military, commercial and policy sectors. The development of a non-contact robot which is fully autonomous is a hard research task. The UNEXMIN robot will have to work in a complex environment with unknown obstacles, mapping the environment and simultaneously gathering geo-mechanical and mineralogical information underwater.

Key research challenges in UNEXMIN are:

- Localization, Navigation and 3D Mapping: autonomous operation in unknown semistructured three-dimensional tunnel structures;
- Explorer structural design: physical robustness, resilience and self-diagnosis capabilities;
- Unique propulsion and altitude control systems.

The development of an Autonomous Underwater Vehicle for such harsh, unknown environments is a substantial challenge for robotics that requires a collaborative effort of several research teams from all across Europe.

In UNEXMIN, three partners are developing the robotic explorer. INESC TEC is in charge of sensors' registration, data fusion, perception and Simultaneous Localization and Mapping (SLAM); UPM is developing Guidance, Navigation and Control software; TUT is in charge of mechanical design and low-level hardware controllers. Additionally, UNIM is developing the scientific sensors and RCI will create post-processing software and data management tools.



Components' view of the software system