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UNEXMIN: an innovative approach for mineral exploration in flooded mines

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UNEXMIN is developing a new solution consisting of three robots for autonomous exploration and mapping of underground flooded mines that cannot currently be studied without major costs or risks. The system will use non-contact capabilities based on a selection of instrumentation to deliver geological and spatial data that can be later processed and analysed. Such assessment can provide useful geo-scientific and topographic information that could lead to the re-opening of flooded mines or creation of new or updated geological models at local and regional levels.

One prototype has already been built with an array of basic scientific instrumentation that includes scanners, sonar imaging, magnetic field measuring units, UV light unit and multispectral camera. This robot – UX-1a – has already been tested at two sites, the Kaatiala pegmatite mine in Finland (June 2018) and in the Idrija mercury mine in Slovenia (September 2018). There are two more field trials planned. One is to be conducted in the Urgeiriça uranium mine, Portugal, using two UX-1 robots simultaneously. The fourth and last pilot will take place at the Ecton copper mine, UK, where the fully-fledged prototype system formed by three robots will work in cooperation to gather spatial and geological data, unveiling the status of the underground flooded part of the mine that no one has seen for more than 160 years and where no accurate survey data exists.

During the Kaatiala and Idrija trials the robot was for the first times tested in a real application environment with success. UX-1 was operational with an umbilical for safety reasons. The trials allowed the team to gain experience and to test and improve the instrument array, with special focus on the scientific instrumentation, which, tailored for the use on UX-1 and this specific environment, needs to see constant adaption. The Kaatiala site represented a flooded former open-pit mine with a connected underground part where UX-1 explored and mapped tunnels up to 30m depth. Idrija represented a “true” underground mine environment. Here UX-1 was able to explore and map a gallery up to 27m deep, in harsher conditions, including low visibility and reduced space for movement. The first fully autonomous mission (without the umbilical cable) was held in Idrija.

Data obtained from the two sites are being processed and analysed. Geological models, 3D-views, virtual reality and fly-throughs are planned to be created and made available from the selected test sites. Parallel to data analysis, autonomy is being improved and implemented in laboratory as are other robotic functions and instrumentation. Better configuration of sensor and navigation settings of the robot, of geoscientific data acquisition systems, with an emphasis of improving mineral detection system and recovery functions are also pursued. Construction of the second UX-1 robot is nearing completion with the third one planned for March. When the technology is ready, the UNEXMIN UX-n robots can assist in shaping the future of mineral exploration, not only in flooded mines, but also in other application environments where deep water is an obstacle to the use of conventional exploration methods.