

Press Release – 2 February 2016



**Software for the EU Horizon2020 UNEXMIN Project: An Autonomous Underwater Explorer for Flooded Mines**

13 organisations from 7 countries across Europe are collaborating in an ambitious project to develop a submersible robotic system for surveying and exploration of flooded mines. The €5M project, funded by the European Union's Horizon 2020 research programme, will include the development of a Robotic Explorer (UX-1) for autonomous 3D mine mapping to gather valuable geological information that cannot be obtained in any other way: in general the mines will be too deep and dangerous for access by human divers.

**4dcoders**, a group of software developers which includes RCI, Rockmate, Geomem, and GeoReka, will lead the development of software to manage and process the expected large volumes of survey and instrumental data from the robot surveys. These will include basic data on location and attitude of the robots, video and photographic data, laser point-clouds, and physical parameters such as pH, ion concentrations, temperature, gamma counts, and others. The results will include a variety of statistical and graphical outputs and will include real and false colour photographs, videos, and multivariate analyses. Particular contributions will also include "fly-through" videos to be created from the processed data by a film unit at the Tampere University of Technology.

A multi-robot system based on UX-1 will represent new technology, made possible by recent developments in autonomy research allowing development of a completely new class of robots, capable of operating underground without remote control: UX-1 will be the first of its kind. Research challenges are related to miniaturisation and adaptation of deep sea robotic technology to this new application environment and to the interpretation of high volumes of multivariate geoscientific data.

Pilot deployments will be carried out at mines with progressively more challenging conditions: Kaatiala feldspar/quartz mine (Finland), Urgeiriça uranium mine (Portugal) and Idrija mercury mine (Slovenia). The final, most ambitious demonstration will take place in the UK with the first modern survey of the Deep Ecton copper mine (UK) most of which has been flooded and inaccessible for over 150 years. This will demonstrate the system's scalability from small missions to the largest ones by increasing the number of deployed autonomous drones, and

supporting multi-robot cooperation in confined 3D spaces with real-time sensor and data fusion for reliable navigation and communications.

The development of UX-1 will open new exploration scenarios so that strategic decisions on re-opening Europe's abandoned mines, many of which may still contain critical raw materials, can be supported by real data which cannot be gathered in any other way.

The robots will be developed by a team headed by Tampere University of Technology, Finland and INESC (Institute for Systems and Computer Engineering of Porto), Portugal, with instrumentation contributed by a team to be led by the University of Miskolc, Hungary. Technology for autonomous operation will be contributed by the Universidad Politécnica de Madrid. The University of Miskolc will provide overall project coordination.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 690008.

A full list of the participants is:

1. University of Miskolc (UM), Hungary
2. Geological Survey of Slovenia (GeoZS), Slovenia
3. Tampere University of Technology, Department of Mechanical, Engineering and Industrial Systems (TUT), Finland
4. Universidad Politécnica de Madrid, Centre for Automation and Robotics (UPM-CSIC), Spain
5. La Palma Research S.L. (LPRC), Spain
6. Institute for Systems and Computer Engineering of Porto (INESC), Portugal
7. Resources Computing International Ltd (RCI), UK (representing **4dcoders**)
8. Geoplano (GEOP), Portugal
9. Ecton Mine Educational Trust (EMET), UK
10. European Federation of Geologists (EFG), France
11. Geo-montan (GEOM), Hungary
12. Empresa de Desenvolvimento Mineiro (EDM), Portugal
13. Idrija Mercury Heritage Management Centre (CUDHgl), Slovenia

The four initial members of **4dcoders** are:

- **Rockmate**, developer of innovative solutions for surface mining operations including blast optimisation and shovel production monitoring as a value added reseller. This includes developing software to process raw data from a laser to create a model of a rockface which is to be blasted.

- **GeoReka! Software** develops geological modelling software. Primarily, the software is aimed at minerals exploration, but it is also used in other areas like quarrying. GeoReka! Software provides affordable solutions without compromising on quality. Its top-notch visualisation is supported by ground breaking tools adapted from other industries to the geological sciences. With experience in engineering, medical science and geological science GeoReka! tries to provide new innovative ways crossing industry boundaries to provide the best modelling tools for the job.
- **GeoMEM** both develops its own and supplies third-party geological and engineering software to the mining, engineering and construction industries. Software development focuses on control applications for industrial devices, in particular, borehole survey instruments and laboratory systems. It includes extensive experience of industrial communications using wired serial, wireless, IR, bluetooth and EtherCAT/CANOpen. Applications cover mathematics, graphics, data analysis, statistics, data export in a range of formats (including bespoke). Development languages include: C#, Visual Basic, C, Pascal on a range of platforms.
- **RCI (Resources Computing International Ltd)** develops VMINE for a variety of geoscience applications, providing database management using an 'open-world' DBMS model; also including a variety of statistical, graphical, and 2D and 3D modelling applications. The principal purpose of VMINE is to be a platform for new research project applications. Software development is mainly in Fortran 95, to take advantage of the very large resource of numerical applications libraries that are available.

Further information from <http://www.4dcoders.com> or from individual web sites of the consortium members.

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GeoReka: Hilco van Moerkerk	<a href="http://www.geo-reka.com">http://www.geo-reka.com</a>
GeoMEM: James Tweedie	<a href="http://www.geomem.com">http://www.geomem.com</a>
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