


# BOOK OF ABSTRACTS

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sample characterization. Representative measurements on CBRNe-relevant samples will illustrate the respective strengths of handheld Raman, dual-wavelength laboratory Raman, and FTIR spectroscopy. The presentation will show how the combination of mobility, wavelength flexibility, and complementary molecular information can strengthen chemical identification capabilities from the incident site to the mobile laboratory.

*(T.S.9.22)* **B.M.D.'s approach to remote CBRNe detection using an autonomous unmanned ground platform**

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Chemical and explosive incidents are among the most immediate and unpredictable threats in industrial, public-order and terrorist scenarios. Responders need reliable information about the threat before anyone enters the hazard area. B.M.D. S.p.A., founded in 1994, works in filtration, CBRNE protection and detection, and security, with more than 30 years of experience as advisor, system integrator and lifecycle partner. Over the years it has built dedicated systems for the CBRN, naval, EOD/IEDD, security and autonomous domains, including the CRN DeSys for the Italian Navy and the N+C alarm system for the U212 submarine. This work presents B.M.D.'s approach to remote CBRNe detection using an autonomous unmanned ground platform. The architecture has three parts: a mobile carrier, a swappable sensing suite, and a resilient remote link. The carrier is an autonomous legged (quadruped) platform that can climb stairs and cross rubble and confined spaces where wheeled or tracked robots get stuck. The sensing suite uses interchangeable payloads selected according to the mission: chemical vapour and trace detection of CWA and TIC, trace and bulk explosive screening, gamma spectrometry and radionuclide identification, bio-aerosol triggering, and air and surface sampling for confirmatory (SIBCRA) analysis. Sensors can be swapped for each mission while the carrier and the fusion layer stay the same. On-board data fusion places every reading on a single live threat map, and a resilient command-and-control link keeps the system working in contested, comms-constrained and GPS-denied environments, so the operator stays at a safe stand-off distance. The platform supports stand-off screening of critical infrastructure, checkpoints and public events; first-response assessment of contaminated or damaged facilities before human entry; and survey and mapping of confined or above-ground sites with geo-referenced hazard overlays. Built from mature, off-the-shelf detection components integrated into a single architecture, the system addresses four operational priorities in the chemical and explosive domain: operator safety through stand-off distance, speed of deployment, flexibility to reconfigure payloads per mission, and resilience in degraded operating conditions.

*(T.S.9.23)* **A method for underwater mine clearance in water areas contaminated with explosive objects**

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This paper examines the pressing scientific and practical issue of improving the effectiveness of humanitarian underwater mine clearance in the context of water bodies in Ukraine being contaminated with explosive ordnance. It is argued that the cleanup of water bodies and water areas is a crucial component of ensuring public safety, restoring economic activity, infrastructure, and ecological stability. Particular attention is paid to the possibility of using search neodymium magnets as a means of retrieving explosive objects from the aquatic environment, the casings of which are made of ferromagnetic materials. The relevance of the study stems from the fact that existing approaches to underwater demining are primarily focused on detecting sea mines or using specialized electromagnetic systems, whereas the issue of using compact permanent magnets to retrieve artillery shells and other cylindrical explosive objects remains insufficiently explored. The aim of this work is to investigate the specifics of using search neodymium magnets for humanitarian underwater mine clearance and to develop a model that accounts for the magnet's geometric parameters, magnetic field characteristics, and the mass and shape of the explosive object. Within the scope of the study, the physical properties of neodymium magnets, their classification by temperature regime and magnetic characteristics, as well as factors affecting their usability in an aquatic environment, are analyzed. It has been shown that water, having a relative magnetic permeability close to unity, weakens the magnetic field only slightly and, provided proper waterproofing is in place, has no significant effect on the magnetic

properties of a neodymium magnet. The article determines the dependence of the magnet's lifting force on the area of its working surface, the magnitude of magnetic induction, and the magnetic permeability of the medium. It has been established that the magnetic induction required to lift a load of a given mass decreases with an increase in the working surface area of the magnet according to a law close to the hyperbolic one. Based on the Biot–Savart–Laplace law, a model of the variation of magnetic induction outside a disc magnet with axial magnetization has been constructed. It has been proven that as the diameter of the magnet increases, the magnetic induction decreases more slowly with distance from its working surface. The features of contact between the flat working surface of the magnet and the cylindrical surface of an explosive object simulating an artillery shell casing are examined. An approach for determining the equivalent air gap between the magnet and the metal cylinder is proposed.

### *(T.S.9.24)* **Development of an intelligent hybrid system for personal air exposure monitoring in military deployments**

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Air quality monitoring in military operational theaters abroad represents a critical challenge for the health protection and operational readiness of Armed Forces. In these environments, personnel may be exposed to complex mixtures of environmental and anthropogenic pollutants capable of causing significant acute and chronic health effects. Traditional stationary monitoring networks are often difficult to deploy or limited to specific contexts, making the use of personal and portable exposure systems essential. However, current commercial devices present a technological limitation: real-time electronic sensors offer immediate warning capabilities but do not collect a physical sample, whereas regulatory mechanical sampling pumps capture the contaminants for laboratory analysis but lack immediate alert functionalities. This thesis investigates the state of the art of portable air sampling and sensing technologies to assess the current technological maturity of the market. By evaluating different commercial benchmarks—ranging from low-cost IoT wearables and multi-gas detectors to high-end mobile laboratories—this work outlines the capabilities, limitations, and operational readiness of existing solutions. The core objective of this study is to define the guidelines and specifications for a new, intelligent hybrid device tailored for military deployments. The proposed system integrates a responsive real-time alarm network with an automated, event-triggered mechanical sampling module. By combining immediate hazard notification with the simultaneous physical collection of contaminants on solid sorbents or filters for subsequent GC-MS laboratory validation, the device ensures both immediate tactical safety and long-term legal-medical traceability. Finally, future technological trends, such as sensor miniaturization and edge computing calibration, are discussed to outline the next generation of ruggedized exposure monitoring tools.

### *(T.S.9.25)* **Detecting explosives and chemical warfare agents on common surfaces**

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The ability to detect harmful substances on surfaces is of high relevance in civil security applications as well as in military scenarios. Laser-based techniques, e.g. Raman and fluorescence spectroscopy, are frequently proposed for a variety of applications that require contactless and fast detection of surface-bound hazards. However, detection of chemicals and explosives on unknown surfaces is generally trying, due to the contribution of the background material to the spectral signatures. A dedicated data analysis can reduce the influence of the surface and improve the reliability of detection. In this study we investigated the potential of Raman and infrared reflexion spectroscopy for the detection of explosives as well as chemical warfare agents and simulants on different surface materials. The hazardous substances include organic and inorganic explosives, like RDX and ammonium nitrate, chemical warfare agent simulants, such as tributyl phosphate, and live agents, e.g. VX. The samples were investigated at a distance of about 75 cm in a standoff backscattering configuration in a laboratory setting. A live data analysis was performed during measurements using a real-time automated detection pipeline trained for the detection of explosives. For verification purposes of the pipeline results, a separate data analysis was performed afterwards. The results highlight the strengths and weaknesses of both detection methods, allowing for a more targeted system design according to specific needs of different scenarios.