

DeFuse: Demining by Fusion of Techniques

Authors: Kaj Hörberg, Jan Larsen

The DeFuse project was initiated by the Nordic Demining Research Forum but is today driven by the participant. Some of the costs for the project are covered by the Norwegian Armed Forces, however the major part of the costs carried by the participants.

Vision and mission

Today's practice typically involve using a combination of methods, however, this is an ad hoc practice with limited scientific support and qualification. Optimal use of today's techniques will thus lead to a needed increase in clearance efficiency and possible cost reduction.

DeFuse is a pilot project with the aim to obtain scientific knowledge about the advantages of deploying a combined approach using existing mine detection and clearance equipment. The intention is to lay the foundation for future experiments which evaluate the feasibility of combining specific methods in realistic mine action settings; however, it is not within the scope of the suggested pilot project to suggest new practices for mine action.

DeFuse will acquire datasets which makes it possible to make reliable statistical analysis of specific hypotheses related to dependencies among different methods. The test merely evaluates the potential of combining mine clearance methods. Consequently, the conclusions do not provide any support for determination of the performance of any specific single sensor or combined sensors in real mine clearance operations.

As the current test is a pilot project, all relevant situations and dependencies for practical mine action will not be investigated. It is suggested to organize a 1-2 days workshop in order to identify relevant factors (physical, technical, operational, etc.), which might be dependent or independent across methods. The result of the workshop should act as input for the statistical analysis.

Background

The overall objective of the suggested pilot project is to obtain scientific knowledge about the advantages of deploying a combined approach using existing mine detection and clearance equipment and procedures already in use. A mine clearance method detect or clears mines with a certain spatial precision, and is defined as the complete set of procedural steps leading to a decision/conclusion about presence or absence of mines in a certain location. For example, the metal detection method consists of the technical equipment, procedures for

calibration, sweeping procedure, and finally the interpretation and decision made by the operator.

The obtained scientific knowledge should be as general as possible by 1) eliminating confounding environmental and other factors, and 2) by careful experimental design and proposal of specific scientific hypotheses. *The objective is to reach conclusions, which can be generalized to situations outside the domain of the test and provide as a foundation for future focused tests and experiments.* The intention is to lay the foundation for future experiments which evaluate the feasibility of combining specific methods in realistic mine action settings.

The general scientific hypothesis is that there is little dependence between missed detections or false alarms by repetitive use of the same method, or by consecutive use of different methods. The acceptance of this hypothesis under variations in the level of detection probability for the individual methods and other confounding factors will lay the foundation for suggesting and qualifying new practices in mine action. However, it is not within the scope of the suggested pilot project to suggest new practices for mine action. The test merely evaluates the potential of combining mine clearance methods (according to the definition above). Consequently, the conclusions of the tests do not provide any support for determination of the performance of single or combined sensors in real operations.

Participants and main responsibilities

Nordic Demining Research Forum (NDRF)

Coordination of the DeFuse project.

The Technical University of Denmark (DTU)

Project management, quality control and statistical analysis of the result.

Denmark's EOD Centre (DANDEC)

Operate the metal detectors. Providing the test area etc.

DAMINAR A/S, Denmark

Providing Mine Detection Dogs.

Gota Engineer Regiment, Sweden

Providing Mine Detection Dogs.

Tohoku University, Japan

Providing the dual sensor system ALIS. (GPR and MD)

Hydrema A/S, Denmark

Providing the Hydrema flail system.

Defence Research Establishment, Norway
Quality control and statistical analysis of the result.

Royal Military Academy, Belgium
Statistical analysis of the result.

Elements of the protocol

Figure 1 displays the overall works packages (WPs) of the test protocol which consist of four phases and two horizontal activities.

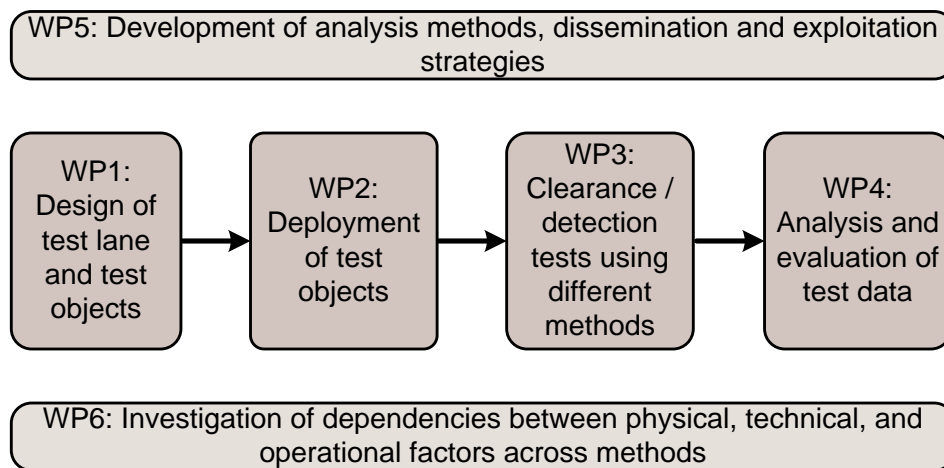


Figure 1: The elements of the test protocol

Knowledge about dependencies between different methods can be obtained by investigating physical, technical and operational properties and factors or by analyzing data from experiments using statistical methods. Both avenues will be followed, but more specific knowledge is obtained by statistical methods. Thus the theoretical investigation of potential dependencies will constitute a foundation and provide as prior assumptions in the statistical analysis.

It is well known that statistical confidence relies on numerous repetitions of the experiment. Thus it is not realistic to reliably determine the influence of many simultaneous factors. Hence we invoked the principle of acquiring many data samples under minimal variation in few factors.

Status

WP 1 and 2 were completed during 2008. To find a test lane and test object design that works for systems that have a capacity of covering areas from 100 to 5000 m² per day was not easy. The capacity was one complication another was the various techniques used, odour for the dogs, electromagnetic for the metal detectors and GPR and kinetic energy for the flail.



Today we have a test field with over 500 test objects that have been buried for about one year. They are spread over 28 000 m² big area divided in lanes 100 by 10 meters.

WP 3 will be divided into two periods during 2009. The first period will start the 25 of May until the middle of June, the second period is in the first half of September.

WP 4 will start in the end of 2009.