

Geneva

Demining R&D at TNO

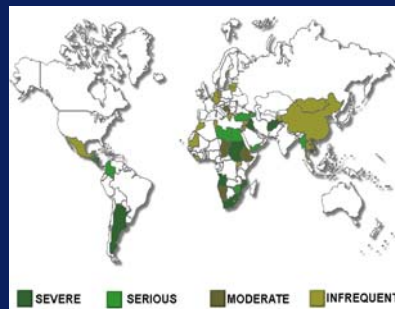
TNO Physics and Electronics Laboratory

Ric Schleijpen, Programme manager
demining



Overview

- Background for research in The Netherlands
- Goal of this presentation
- Research sponsors
- Research topics
 - Short term
 - Long term
- Facilities and applications
- Issues and questions for discussion



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Background for research in The Netherlands

- Mine Ban Policy: Ratification Ottawa Mine ban Treaty (1999)
- Pool demining instructors (80, 1998-1999): Dutch Armed Forces
- Mine Action Funding (1996-1999): US\$ 40.2 million
- UN Trust Funds: US\$ 14 million
- Victim Assistance: US\$ 1.8 million
- Stockpiling, destruction of 440 000 landmines: US\$ 0.3 million
- Research (1997- 2000): US\$ 11.9 million
- (Average 20 US\$ million/year)



What is TNO

- TNO Organisation
- Netherlands Organisation for applied scientific research
- Established by Law in order to
 - 1) give independent advise to government
 - 2) apply knowledge generated by universities and in-house scientists in projects for users, customers, industry



Goal of this presentation

- Show some technological opportunities
- Get input from the field

photos taken by TNO during visits/tests in

Croatia

Mozambique



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Research sponsors in the Netherlands

- Sponsors of research programme
 - Ministry of Defence (Direct project funding)
 - Ministry of Defence (Strategic research funding)
 - Royal Netherlands Army
 - Minister of "Development Co-operation"
 - European Union
 - International partners
 - TNO Corporate funding



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Research topics

Projects

- Short term:
 - Neutralisation
 - Protection
 - Mine Database,
 - Metal detection (participation in IPPTC)
- Mid and Long term:
 - Focus on Detection, GPR, TIR, MD, Explosives detection,
 - Data fusion,
 - Airborne detection
 - Sensor performance modelling

Some examples of projects

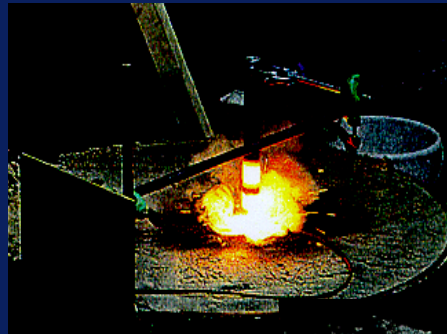


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Neutralisation (1)

- Thermite
- Explosively Formed Projectiles
- Foams / Emulsions
- Bomblet/Mine Attenuator



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Protection

- **Vulnerability test Aardvark**

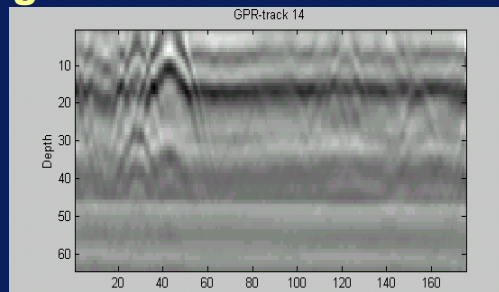
Instrumented Hybrid 3 dummy for measuring crew response



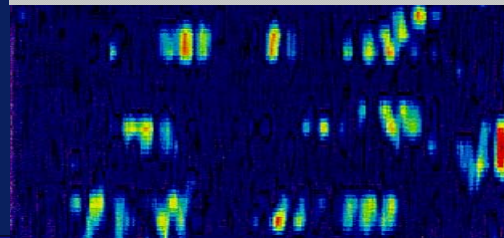
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Detection Ground Penetrating Radar



- + All objects below surface detected
- Problems with surface objects



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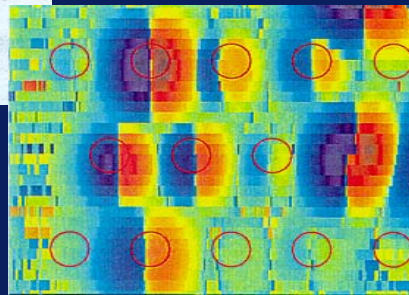


Detection Metal detection



Participation in IPPTC

- Canada, US, UK, Netherlands, EU-JRC
- 70 COTS Metal detectors tested

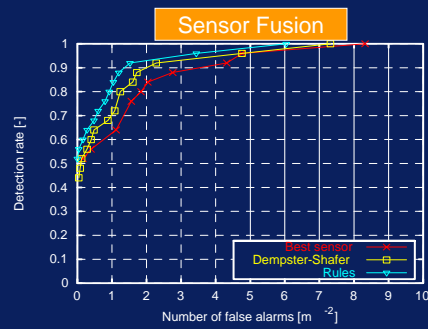
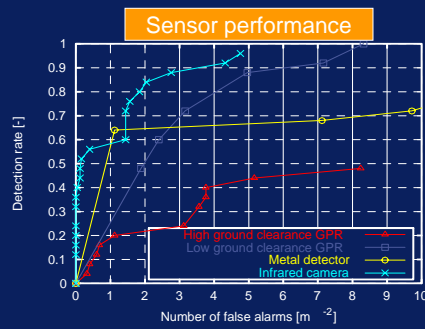


- + Good results for metal mines
- Problems for non-metal or minimum metal mines



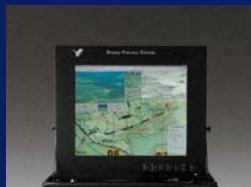
Detection Sensor Fusion: ROC curves

- Significant improvement compared to individual sensor



Airborne detection

- Detection of minefields by detecting indicators
EU project ARC: Airborne minefield area reduction
- Recent data collection tests in Croatia



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Test facilities: Test lanes

Lanes

- Construction without metal
10 m x 3 m x 1.5 m
- Different soil types
- Water level control
(separately per lane)

Platform

- Free of metal
- Different combinations of sensors possible
(maximum payload 600 kg)
- Position accuracy of 1 cm in all directions
- Sensor height is adjustable
- Computer controlled movement
- Continuous position measurement



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IPPTC: Evaluation of metal detectors for (humanitarian) demining

- **Objective:** to assist the user in his selection process for the procurement for metal detectors by providing a 'consumer-test' report.
- **International cooperation:** US, UK, Ca, EU and NL.
- **In-soil tests:** In controlled conditions at TNO, 70 detectors, 4 soil types
- **In-air tests:** in Ca at CCMAT, max. detection distance, reproducibility of calibration, influence of moisture on sensor head, influence of sweep speed
- **Human factors and ergonomic aspects (UK)**
- **Field tests:** Cambodia and Croatia, indigenous deminers, highly magnetic soils
- **Reports will be published very soon**

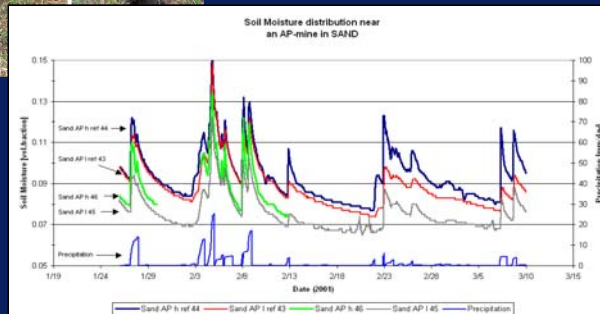


Measurements and Modeling of Soil Water Distribution (1)

- **Background**
 - IPPTC test has shown that soil characteristics can dominate Metal detector performance
 - Water content affect soil properties
 - dielectric constant, electrical conductivity
 - heat capacity, heat conductivity
 - Water content therefore affects the performance of many sensors
 - GPR, TIR, EMI, Passive MW, Vapor detector,...
- **What do we actually measure ?**
- **Measurements under different moisture conditions at instrumented TNO test site**



Measurements and Modeling of Soil Water Distribution (2)



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Issues and questions for discussion

Operator

- How much training is acceptable ?
- Which level of information is to be presented ?
- How to present the information ?

Equipment Support

- How much maintenance can be done in the field ?
- Can the sensors be tuned to local conditions ?
- Transport, power supply etc..

Equipment cost

- Initial cost
- Life cycle cost
- Cost per m² in operation

Depends on type of equipment



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