

Overview of DeTeC Activities and AP Mine Detection “State of the Art”

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1. DeTeC Presentation

- Activity triggered in 1994 by John Walker (founder of Autodesk) -> development of the Pemex robot (Ph.Mächler)
- Presently (1996-97) supported by the Foundation ProVictimis (Geneva), the Swiss Federal Department of Foreign Affairs (DFAE) and by the EPFL.
- Currently staffed with 5 engineers (full time) plus several part-time contributions. Physically located at the LAMI.

Three main objectives:

1. Develop by end 1997 a man transportable anti-personnel mine sensor that significantly reduces the false alarm rate -> (at least) GPR and metal detector will be used. Detector acquisition, test system setup.
 2. Participate in long term research projects at international level
 3. Encourage exchange of information (Web, scientific conferences)
- Documentation on the Web:

<http://diwww.epfl.ch/lami/detec/>

2. The “Pemex” robot (1995)

- Original idea: a lightweight and cheap semi-autonomous robot to detect mines and mark their location for further action ->

simple design with 2 driving wheels and a third support point (half-sphere) containing the sensors. One full scale prototype built.

Technical Details:

- Weighs less than 16 kg (5 kg for motors and accumulators, 5 kg for the two wheels, 3 kg for the chassis and 3 kg for the half-sphere and associated electronics)
- Mountain bike wheels (size can be increased to reduce pressure)
- Scans a 1.2 metres wide area while moving forwards
- Autonomy around 60 min, max speed 6 km/h
- 68831 microprocessor based, piezo Polaroid and PSD distance sensors
- Navigation software tested on reduced-scale models (simple navigation based on odometry and compass)

SENSORS...

3. Humanitarian Demining “State-of-the-Art”

- Metal detectors and prodding...
- Dogs to sniff explosives (e.g. Mechem, South Africa)

Delimit minefield perimeter, check roads

Detection of single mine/UXO

- Mechanical devices
- Mine neutralisation

Humanitarian Demining Peculiarities:

- Security measures - “football field” test
- cost (labour, sensors) and financial situation of 3rd world countries
- deminer’s instruction level vs sensor complexity (example: metal detectors)
- false alarm rate
- vegetation, displaced mines
- Certification of new products/techniques

5. Remarks and Overview of other detection systems

- Metal detectors will still be used for quite some time
- No “Silver Bullet” seems to be around -> sensor fusion. Different combination of sensors for different situations?
- Ground Penetrating Radar is slowly reaching maturity, but still way to expensive -> alternatives such as the Livermore Micropower Impulse Radar?

Other systems:

- Vapour Explosive Detection
- Bulk Explosive Detection
- Infrared Sensors
- Magnetometers & Gradiometers for the detection of Unexploded Ordnance (UXO) - ferrous objects. Will not be discussed here
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6. Interesting Research Projects in Europe and Abroad

(emphasis on portable and vehicular systems, and AP mine detection)

Several countries are (believed to be) working more or less on their own, amongst them (information available):

- **Sweden: FOA** (Swedish Defense Research Est.), GPR + MD + odour sensor (Bofors). Several years of experience; portable and vehicular systems, probably applicable to humanitarian demining
- **Denmark: CAT** (Centre for Advanced Technologies), manages R&D project for a multisensor vehicle
- **Great Britain: DRA/DERA**, military vehicular and GPR systems, fielded > 2000. Adaptable to humanitarian needs? ERA: manufacturer of GPR systems
- **Netherlands: TNO** research organization, active in infrared and multispectral detectors. Recently also GPR?
- **Germany: various manufacturers of metal detectors. Dornier** working on the ODIS system (rotating sensors for imaging etc.). A vehicular system might also be under study.
- **France: SATIMO** (Supelec spin-off) active in microwave imaging, supplied a system to the French Army for the detection of ATs. **Thomson-CSF Radant** developed a stepped frequency radar for vehicular applications, large experience.
- **Austria: Schiebel**, metal detectors. Commercially available array.
- **Switzerland: DeTeC** at the EPF Lausanne.
- **Italy: JRC** (Joint Research Center) in Ispra - Dr. Sieber. Reference center for an EC project?

- **Israel:** **ELTA** GPR, one of the few build for landmine detection (ATs). Very few details available.
- **Australia:** very active in the GPR and metal detector field, also working towards an integrated system.
- **South Africa:** are about to start a new project on a multisensor system.
- **United States:** a number of projects sponsored by the Army, Navy, DARPA, ... Amongst them:

HSTAMIDS (Army) (Handheld Standoff Mine Detection System): GPR + MD + IR, 2 teams. Similar detectors for vehicular systems.

DARPA: initiative on chemical/biological sensors (25 M\$ in 3-5 years!?)

- **Canada:** also very active in humanitarian demining activities. working on a multisensor system, the **Improved Landmine Detection Project (ILD)**:
 - 1) Schiebel array of metal detectors (front)
 - 2) ELTA GPR array (front)
 - 3) Forward Looking Infrared Camera (FLIR) (front)
 - 4) Thermal Neutron Activation (TNA) (back), confirmatory device for selected targets

7. Conclusions and Suggestions

- Sensor fusion seems unavoidable
- A (signature) database will have to be set up - maybe already being done?
- Define a standard set of tests -> reproducible experiences
- Understand well the humanitarian demining needs and constraints
- Work on real mines and go on the ground whenever possible!