

# The Humanitarian Demining Problem: Current Status and Future Prospects

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# Law and Standards in Mine Action

Source:

Geneva International Centre for  
Humanitarian Demining (GICHD)

# Anti-Personnel Mine Ban Convention (APMBC)

The APMBC was adopted on 18 September 1997 and entered into force on 1 March 1999.

It has a clear humanitarian goal.

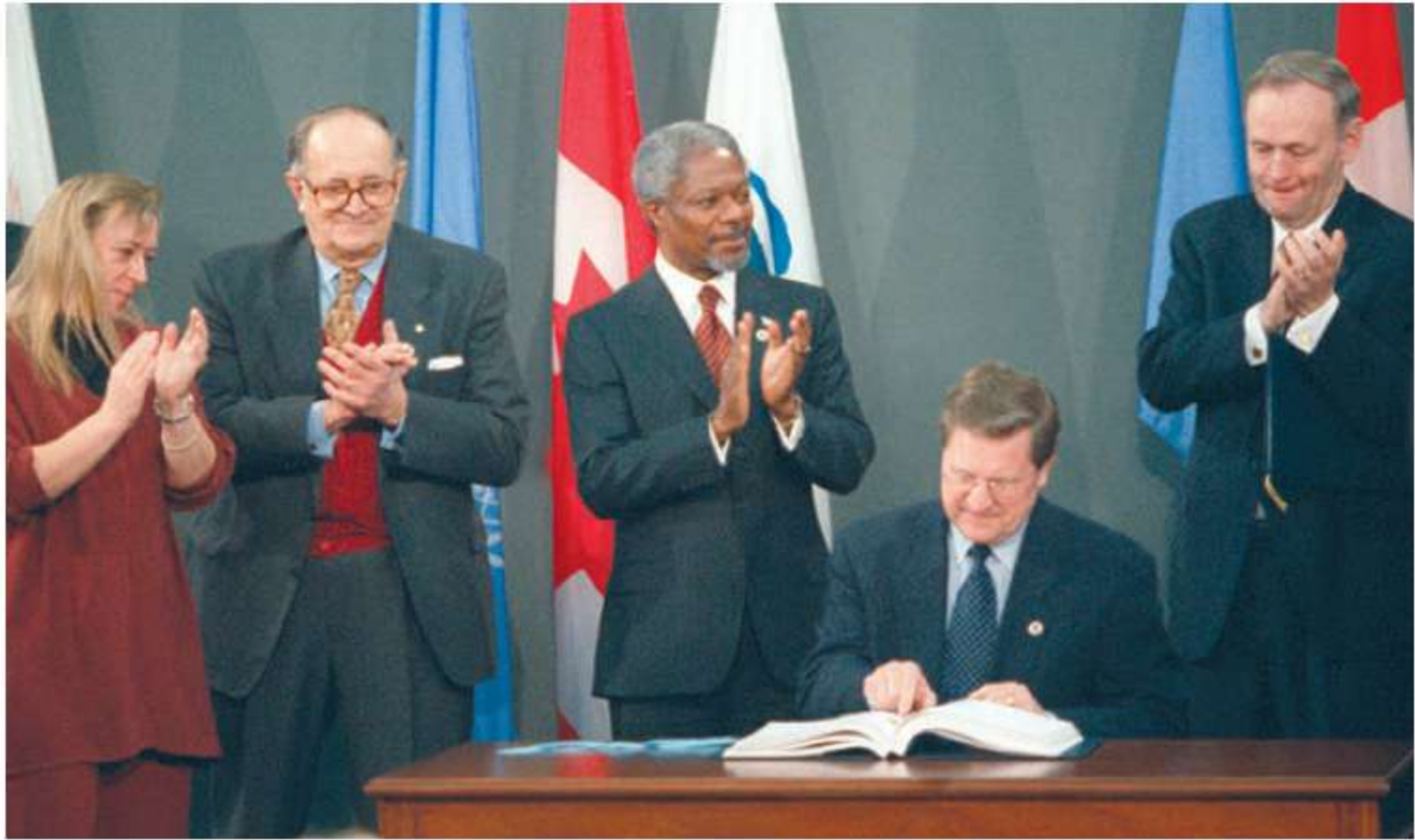
Its preamble opens with a paragraph that highlights the extent of civilian suffering from landmines:

*‘States Parties [are] determined to put an end to the suffering and casualties caused by anti-personnel mines, that kill or maim hundreds of people every week, mostly innocent and defenceless civilians and especially children, obstruct economic development and reconstruction, inhibit the repatriation of refugees and internally displaced persons, and have other severe consequences for years after emplacement.’*

# The Anti-Personnel Mine Ban Convention :

- Prohibits the development, production, use, transfer and stockpiling of antipersonnel mines.
- Requires the destruction of stockpiled antipersonnel mines within four years.
- Requires the clearance of emplaced anti-personnel mines within ten years.
- Requires support for assistance for victims.

# Mine Ban Treaty (Ottawa, 1997)



World activists go back to Ottawa to mark Mine Ban Treaty's 10<sup>th</sup> anniversary, 2007

# The Mine Ban Treaty



There are 161 States Parties and one signatory to the Mine Ban Treaty.



# Mine Ban Treaty status



# Humanitarian demining problem in figures

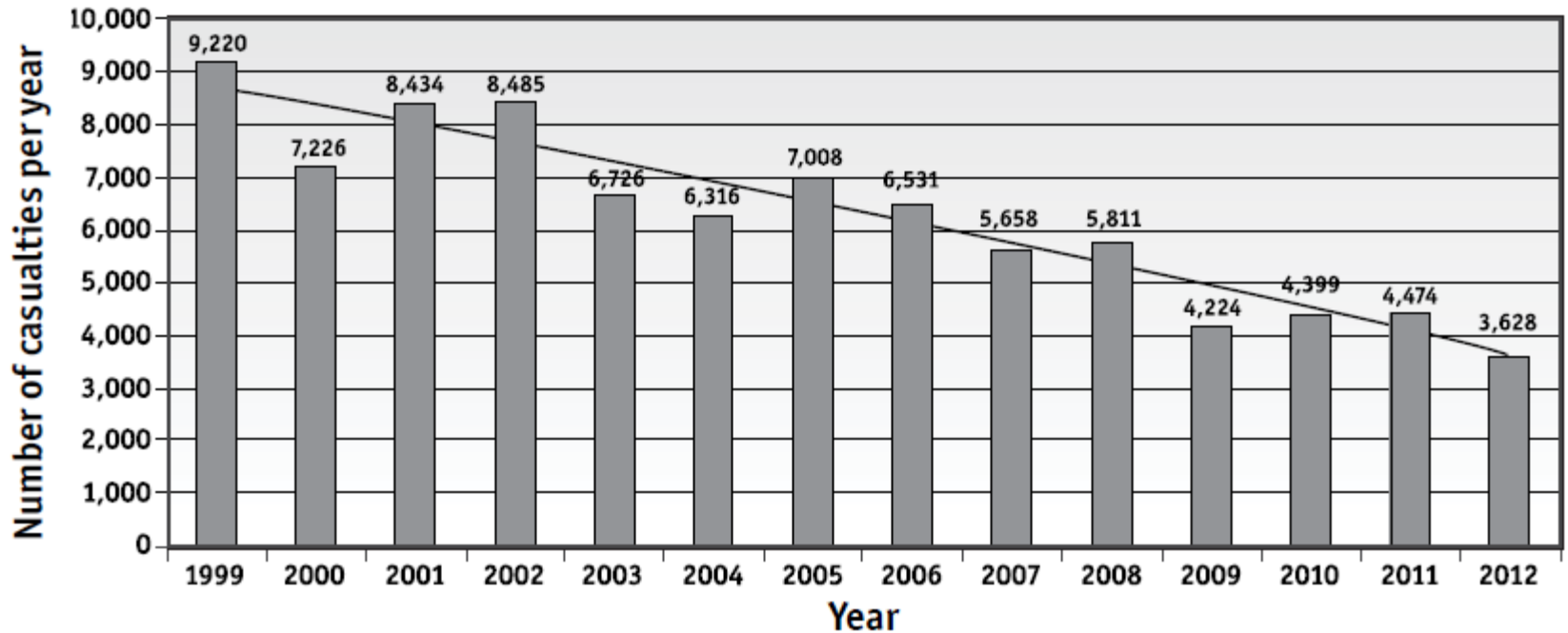
Source: Landmine Monitor 2013





# Casualties

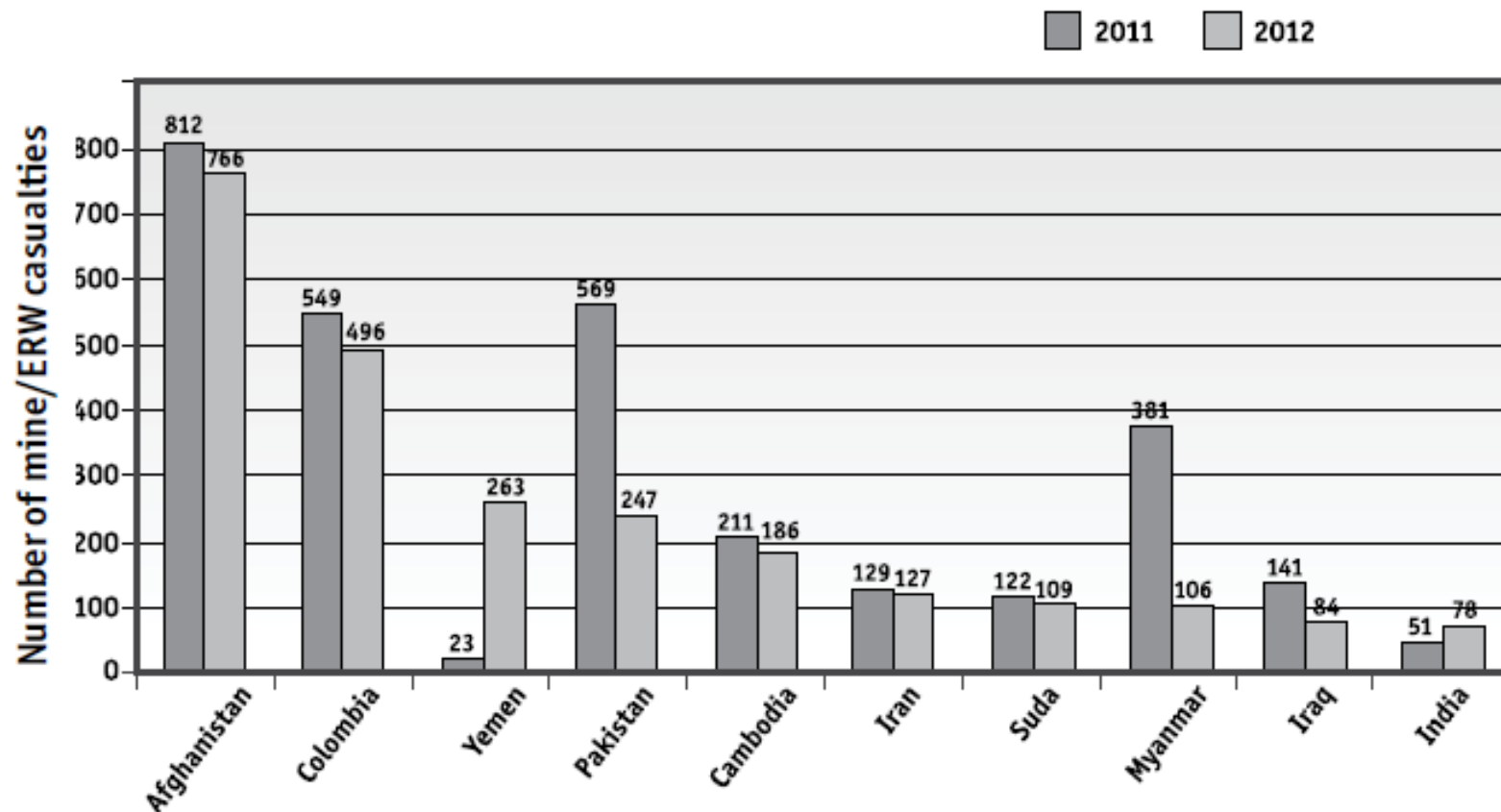
Number of mine/ERW casualties per year (1999–2012):  
Retrospectively adjusted totals



Note: ERW = explosive remnants of war

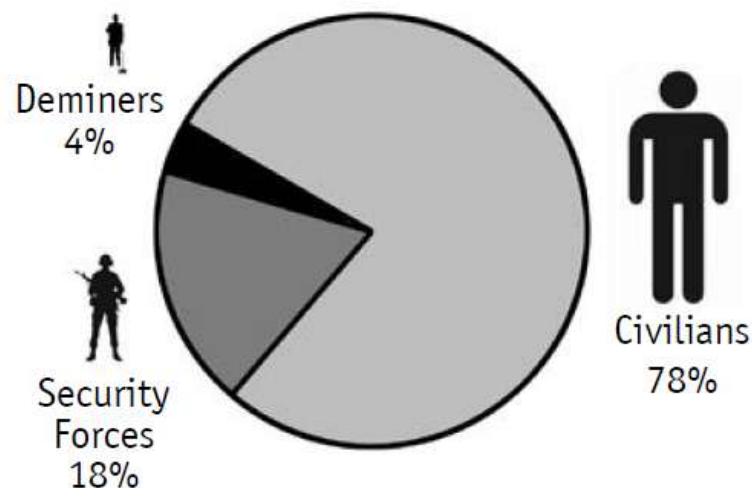
# Recent casualties geography

Annual changes (2011–2012) in mine/ERW casualties for the 10 countries with the most casualties in 2012



# Casualties demographics

Mine/ERW casualties by civilian/military status in 2012<sup>31</sup>

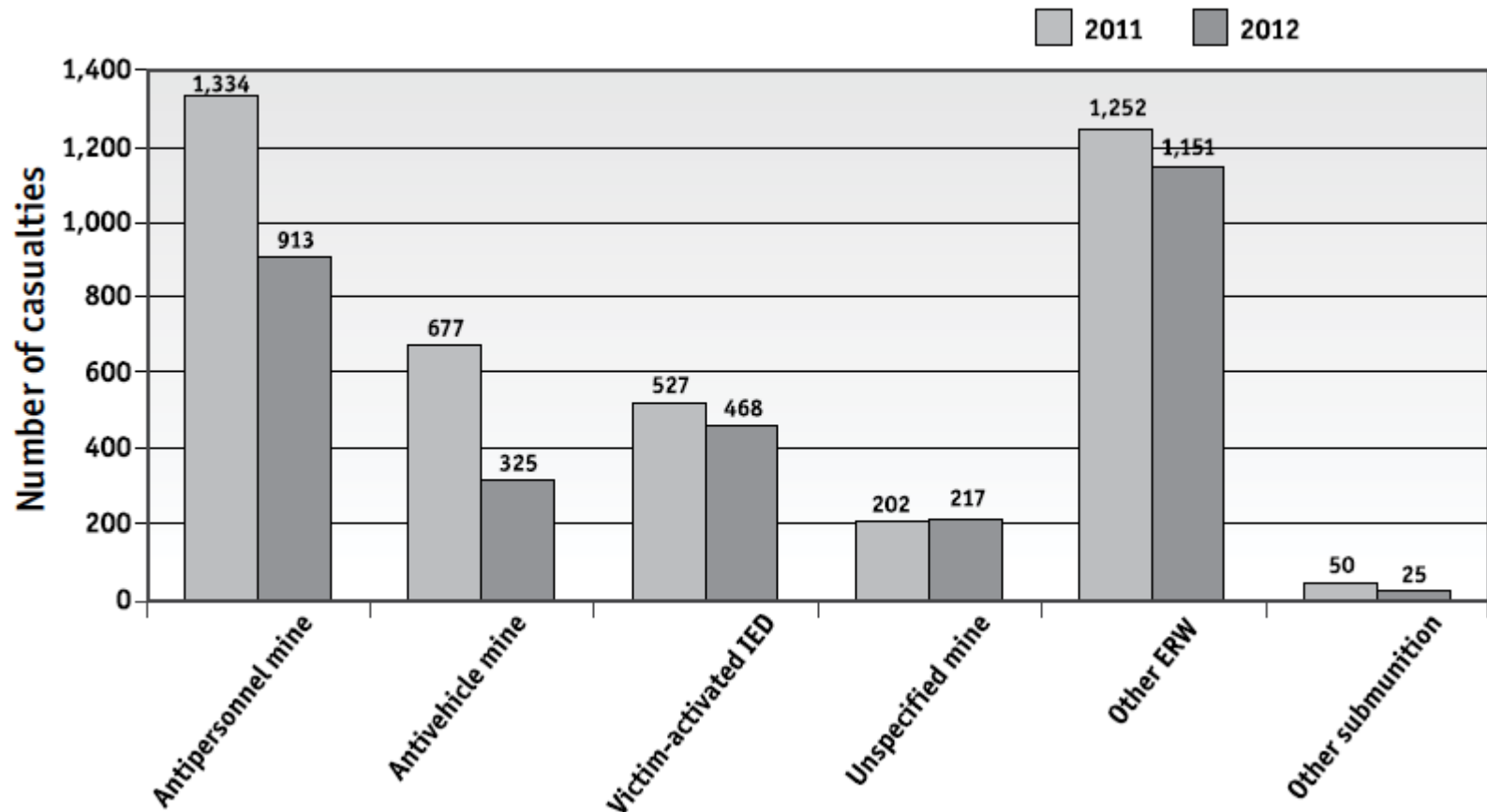


Mine/ERW casualties by age in 2012

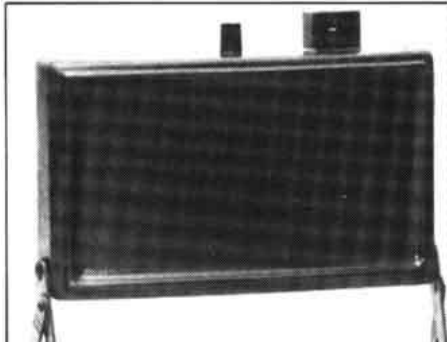


# Detection and clearance of what types of explosive devices ?

Casualties by type of explosive device in 2012



# How are made AntiPersonnel (AP) mines?



**Metal mine SMI 21/3C, austrian (length 240mm, weight 8.20kg)**



**Metal Mine NR 442, Belgium (length 245mm, weight 4.50kg)**



**Metal mine PP-MI-S1, Czechoslovak (length 96mm, weigth 1.75kg)**



**Non Metal Mine FMK-1 MOD 0- Argentina (diameter 82mm, height 39mm, weight 251g)**



**Plastic Mine type 72 (diameter 79mm, height 37mm, weigth 140g)**



**Plastic Mine PMA-2 plastic, Yugoslavia (diameter 68mm, height 61mm, weight 135g)**



# Other Unexploded Ordnances (UXOs)



Nato Science for Peace Program with Egypt (Picture El Alemein , Western Desert)



# Recently are common also Improvised Explosive Devices (IEDs) and Cluster Bombs

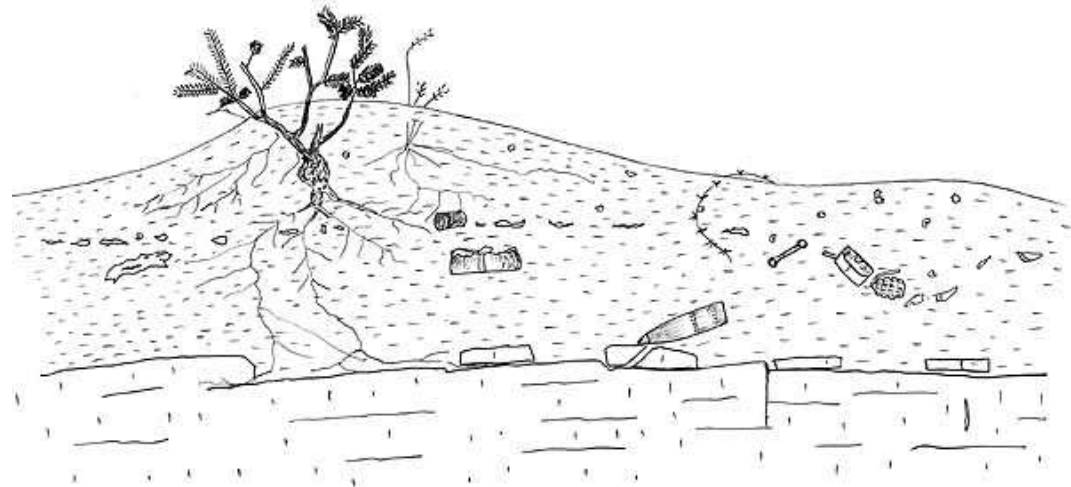


Victim activated or  
remote control triggered IEDs



Cluster bombs are deployed  
on large areas and can be  
found not only on the ground

# Difficult environments



- Unstable soil
- Vegetation
- Stones
- Clutter objects: Shrapnel...

# Acoustic and Electromagnetic Waves, Electronics, Robotics and Mechanics for AP/IED/UXO detection

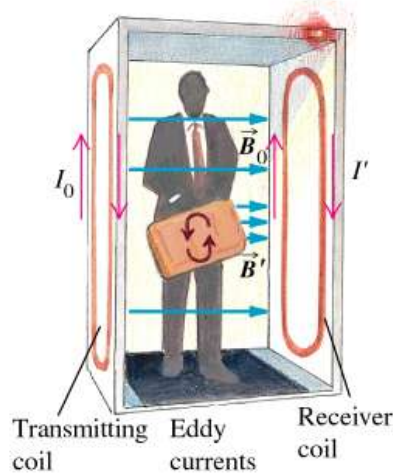
Aims of the research on new methods and equipments:

- Increase safety of deminers
- Higher productivity (square meter/day)
- Lowering the cost (euro/square meter)
- Detection of different type of threats

# Metal detectors

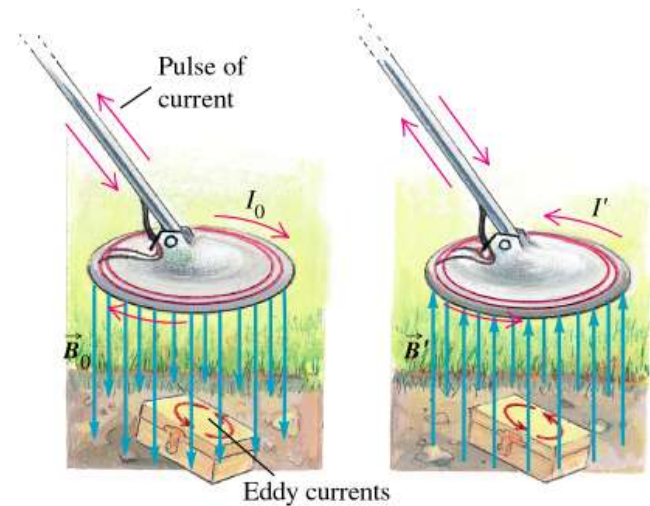


CEIA CMD



(a)

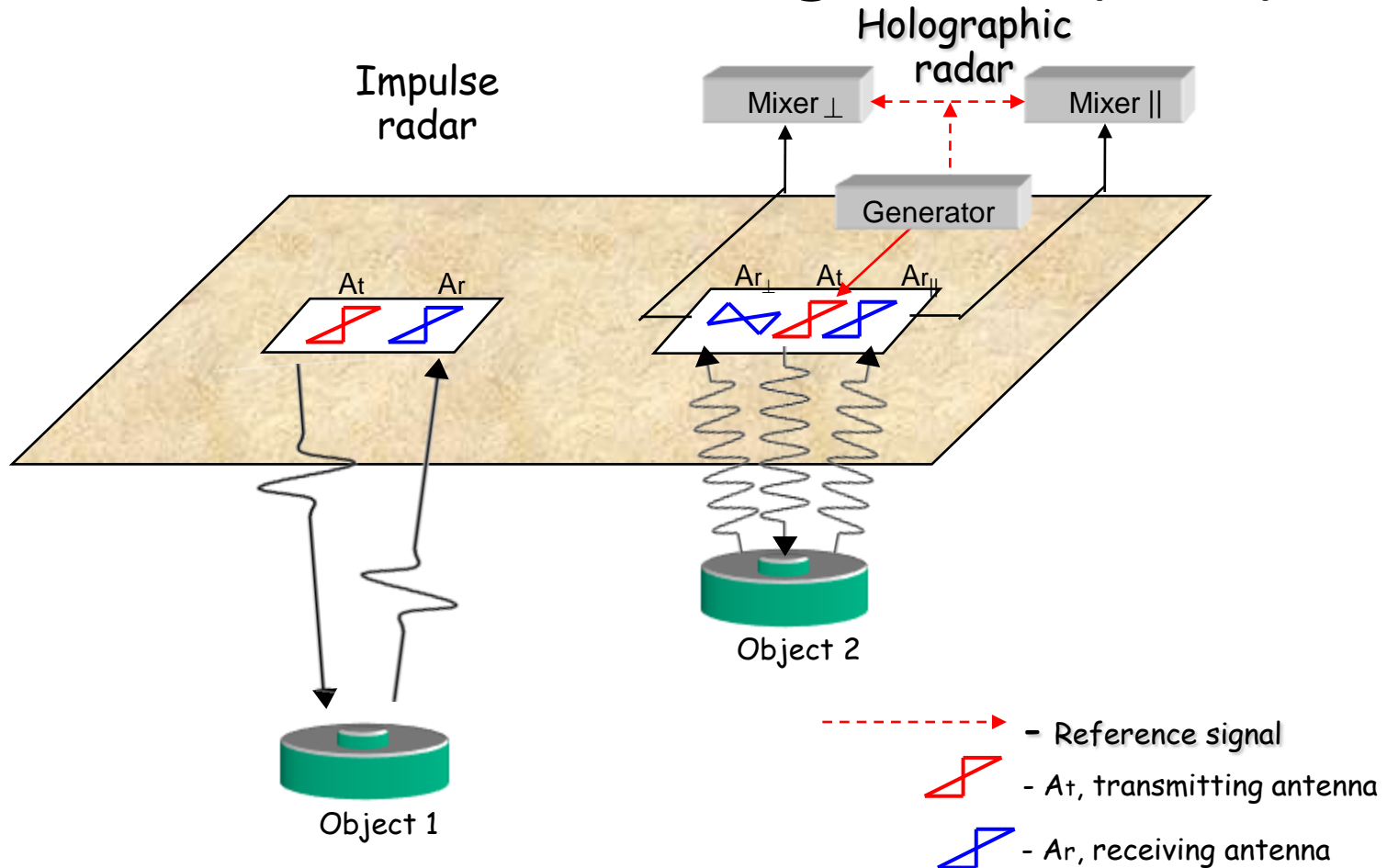
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(b)

- reliably detect very small metal content ( $< 1\text{gr}$ )
- mature technology (since WW2), portable hand held equipments
- standard procedures and guidelines for deminers
- high false alarm rate for plastic mines with very low metal content due to other clutter metal objects

# Ground Penetrating Radar (GPR)



- portable devices under field evaluation, hand held or mounted on robotic vehicles
- low electrical impedance contrast between plastic mines and dry soils, high attenuation of wet soil (soil moisture and surface roughness influence)
- very shallow objects with small dimensions can be detected with new holographic radar surface scan



# Integration of a metal detector and an impulse Ground Penetrating Radar (model Minehound, ERA Technology UK)



GPR ballast PMA1 depth 10cm    Metal Detector ballast PMA1 depth 10cm



# Robotics and Mechanical equipments



Armored Vehicle for soil preparation before detection (ABC General Engineering Florence, Italy)



Vehicle Mine Detector (VMMD) with GPR and Metal detectors mounted on the robotic arm.

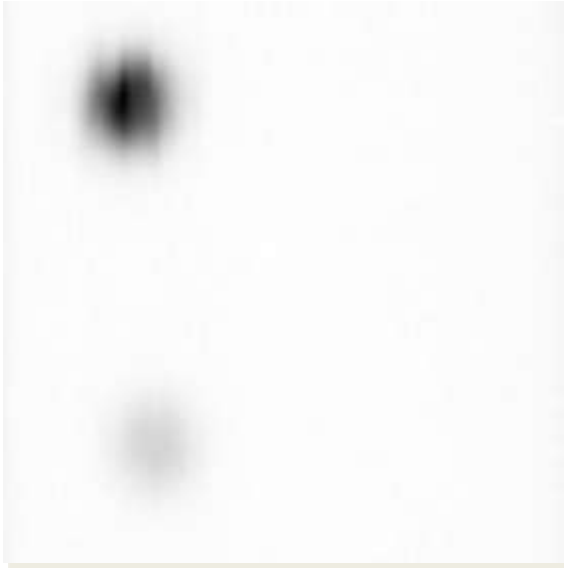
# Intergration of subsurface Holographic Radar (Rascan) and metal detector (Metal Scan)



**NATO - Russia Science for Peace program, NATO project 2006-2009**

# Field tests

## MetalScan



Single induction metal detector image

- Two metal targets
- No image of wire

## RASCAN



Cycling through 10 images (5 frequencies at 2 polarizations)

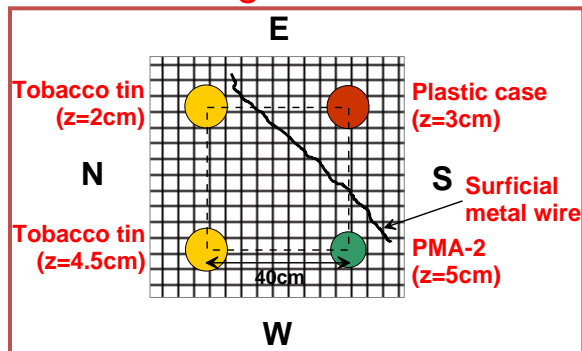
- Two metal, one plastic targets
- PMA-2 off grid ☹️
- Clear image of wire
- Visible knee print (porosity effect?)

## StructureScan



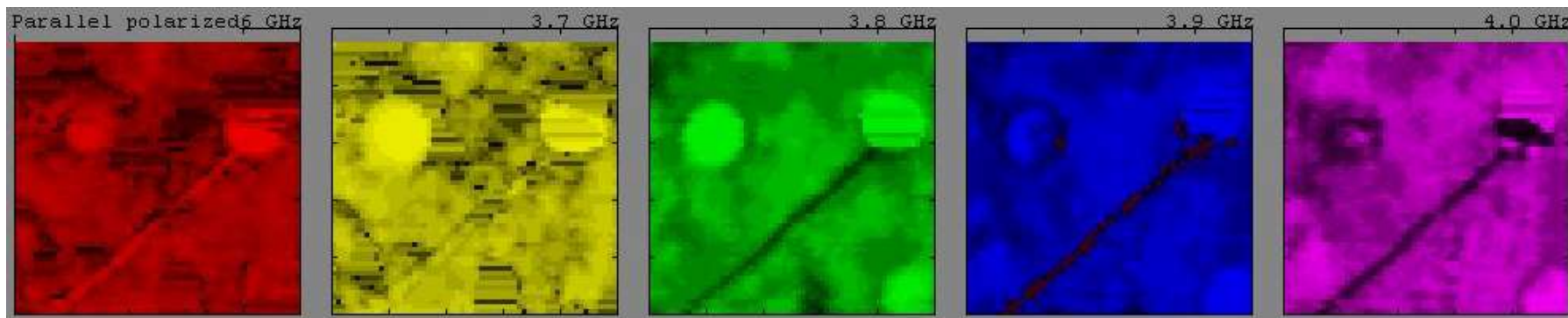
Cycling through 5 depth slices

- Two metal, one plastic targets
- PMA-2 off grid ☹️
- Clear image of wire





# Data fusion and single display



Sequence of scan at 5 frequencies  
(3.6-4)GHz.

Single display with high resolution with  
different buried objects detected with  
color display



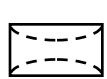
**Holographic radar single display**

# Research working group



# Sensorized acoustic prodder

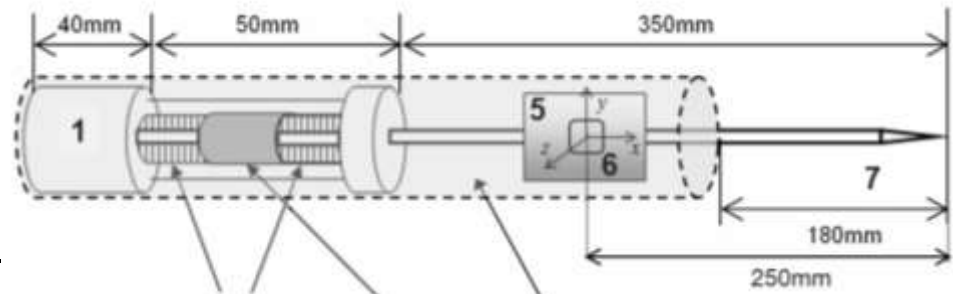
Acoustic detection of  
Compliant objects



Tensile  
phase



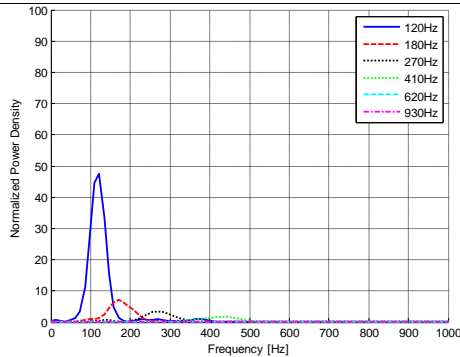
Compressive  
phase



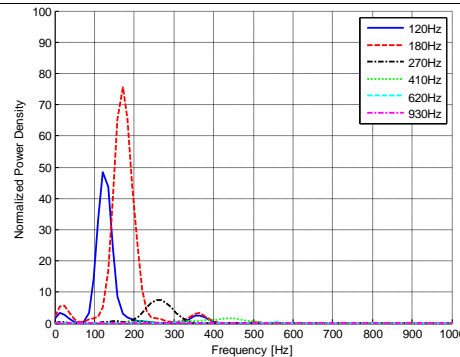
Patent WO2012160578

DUST GRAVEL

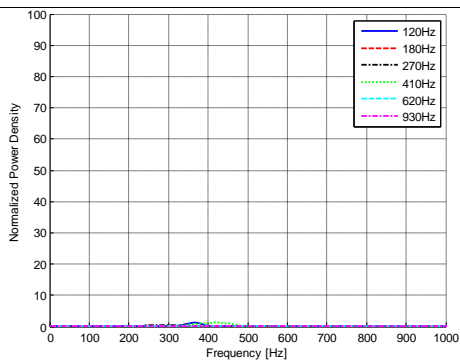
PLASTIC BOX



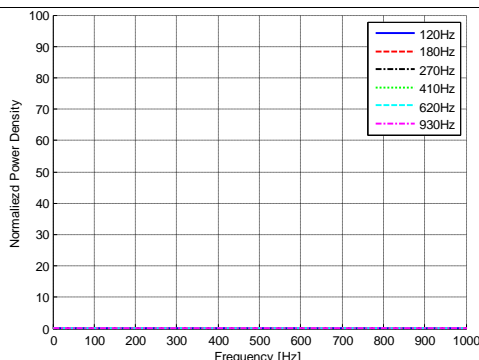
TIN



WOODEN DISC



BRICK





# New perspective of research

Swarm of cooperating robots (SWARMBOTS) with specialized sensors for autonomous mission of detection equipped with a metal detector, a holographic radar and an acoustic prodder



# Supporting actions to research

The humanitarian demining needs both political and applied research actions.

International collaborations and projects are essentials:

an example is the NATO Science for Peace program and Mediterranean Dialogue countries.

# International projects strengthen also the “SCIENTIFIC DIPLOMACY” among countries in the world

**Science diplomacy** is the use of scientific collaborations among nations to address common problems and to build constructive international partnerships. Many experts and groups use a variety of definitions for science diplomacy. However, science diplomacy has become an umbrella term to describe a number of formal or informal technical, research-based, academic or engineering exchanges.

# Some definitions of scientific diplomacy

In January 2010, the [Royal Society](#) and the [American Association for the Advancement of Science \(AAAS\)](#) noted that "science diplomacy" refers to three main types of activities:

1. "Science in diplomacy": Science can provide advice to inform and support foreign policy objectives.
2. "Diplomacy for science": Diplomacy can facilitate international scientific cooperation.
3. "Science for diplomacy": Scientific cooperation can improve international relations.

Selected  
**2010**

# The Royal Society's 350th anniversary **Summer Science Exhibition**



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Thanks to the contribution of the research  
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