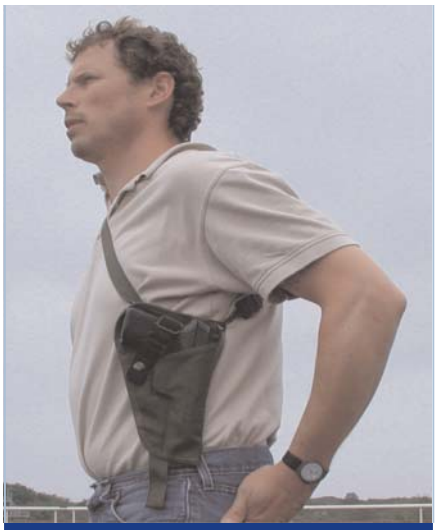
Defence, Security and Safety

TNO | Knowledge for business

Concealed weapon detection

In present-day society the detection of concealed weapons or explosive material rapidly becomes more important. There is a trend towards the prevention of carrying weapons by people in every day life. At the one hand this is due to the increase of violence in everyday life, on the other hand it is caused by the possibility of terrorist attacks.



Weapon in holster.

Hidden under coat.

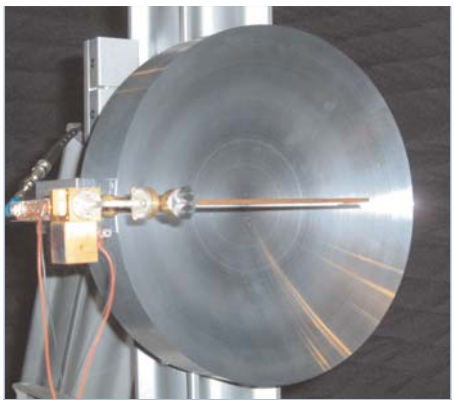
Still revealed.

It is not only a matter of attention at airports or other places where many people gather, but also in city streets. Merely a law against the carrying of fire arms is difficult to maintain. Not only because of the difficulty in detecting such weapons, if properly concealed, but also because of the time consuming action that is to be undertaken in order to find such a weapon. A physical body search, for weapons and explosives hidden under clothes, is of course an effective measure for detection. In many situations, however, the negative aspects of such a body search, like duration, risk for personnel and discomfort of personnel and the people to be searched, can become such an issue that different methods must be applied.

At airports, metal detecting devices, in varying degrees of sophistication, are used to search people, together with roentgen systems for luggage search. This latter technique recently also came in use for body search, but on a strictly voluntary basis. This is obviously caused by the fact that active radiation is used to search human bodies and this is not allowed, nor commonly accepted, without explicit consent. Other possible sensors, like visual or infrared cameras, fail to suit the purpose, reason for this is that they are not capable of looking through clothes, which is mandatory for concealed weapon detection. When another band of the electromagnetic spectrum is used the capabilities rise enormously, even without using active radiation. This occurs at the mm-wave band, ranging approximately from 100 GHz to 300 GHz. At these frequencies, well below Terahertz and infrared, three important phenomena lead to a suitable solution for concealed weapon detection:

- clothing and other similar material is transparent, whereas metal and very dense material is not.
- the natural radiation of objects, known from Plancks theory, at these frequencies is very material dependent.
- the reflection of background radiation (from the sky, the sun or man-made objects like buildings) by metal is better than the reflection by the human body.

Artist impression



Actual sensor

These three phenomena together make that a metal or dense material object can be distinguished from the human body, irrespective of clothing that is surrounding the body. The contrast between metal and human body can be measured with a radiometer, a suitably sensitive receiver of electromagnetic radiation.

The concealed weapon detector shown in these images works at 94 GHz and is mechanically scanned in order to sense all points in a scene. Its patent pending antenna, especially designed for this purpose at TNO, only receives data from a specific point in space at which the device is directed, so the scanning is needed in order to obtain a complete image. No post processing is needed, the images can be formed instantly on a computer screen, simply by plotting the pixels obtained from the radiometer. The result of some measurements with the TNO system can be found in the images at these pages. They clearly indicate the capabilities.

Weapon hidden under coat.

The mm-wave image reveals.

TNO Defence, Security and Safety

'TNO Defence, Security and Safety' is the title under which TNO operates as a strategic partner for the Dutch Ministry of Defence and makes innovative contributions to enhancing the security of the Netherlands both at home and abroad. We also use our accumulated knowledge for foreign governments and for defence-related industries.

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