

Problem of Explosive Detection on Human Subjects

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In 2004-2005 the NATO-Russian Explosive Detection Working Group (EDWG) of the NATO Advisory Panel on Security-Related Civil Science and Technology has prepared a proposal for a special research program to develop methods and equipment suitable for stand-off detection of explosives carried by mobile subjects (primarily – suicide bombers). This problem has been ascribed high priority because of absence of any applicable technology to deal with the multiple incidents involving suicide bombers and car bombs, used recently by terrorists both in NATO countries and Russia. As member of this expert group I will try to summarize general conclusions reached during the development of this Program.

The EDWG has formulated mission scenarios and requirements for technology, that could be acceptable to solve the problem:

- Detection should be harmless and unnoticeable to person under inspection
- Detection device may be portable or stationary
- The sensor (or sensors) may be separate from the registration unit
- The detection distance should be between 1 and 10 meters
- The HEX carrier person will be moving, so detection must be done in “real time” – preferably in times less than one second

Regarding these requirements various existing detection principles have been discussed and broken into two groups – bulk detection methods and trace detection methods :

Bulk Detection:

Terahertz-Wave “Vision”

MM-Wave and Microwave imaging

NQR investigation

Advanced (low-dose) X-ray Imaging

Trace Detection (distributed detector network)

Chemical Detectors based on molecular fluorescence

Ion Mobility Spectroscopy

Gas chromatography with surface acoustic wave detector

Stand-off laser techniques

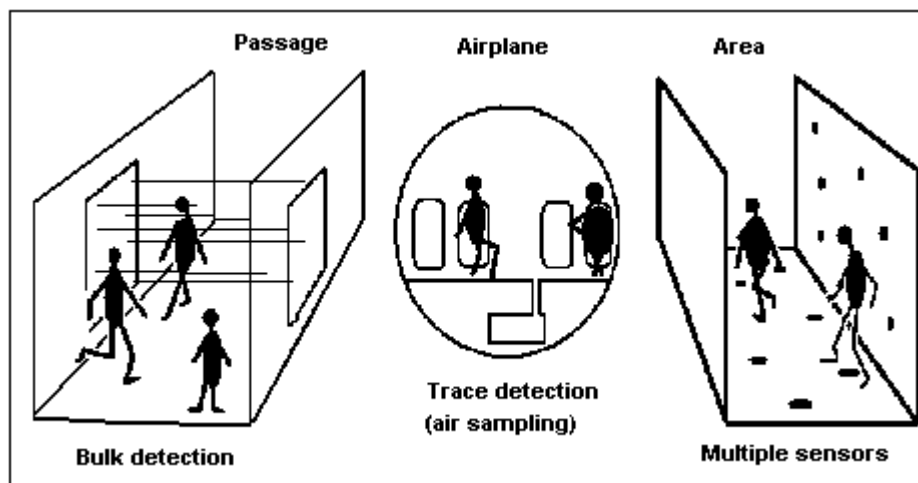


Fig.1. Detector positioning options

Important issue of possible detector positioning has to take into account a compromise between detection range (not less than one meter) and the range at which the moving subject will not notice the inspection. This requirement excludes usual “portal” technology, if this needs stopping the subject and needs him to pass through a narrow gate, but permits to consider real-time inspection of people moving in some wide passageway. Various trace detectors could be used also in a “sealed” closed room (e.g. passenger cabin of an airliner) – in this case air can be sampled by air condition unit and some warning signal of presence of explosive generated for security action (e.g. to prevent take-off of a flight). Similar warning signal could be generated if traces of explosive are detected by a network of chemical sensors in a larger area, such as shopping mall, stadium or transport terminal.

Whatever method or technology will be proposed, the application of the method will meet with many difficulties and restrictions, both obvious and not so obvious.

Obvious difficulties, for instance would require negligible dosage (if any), if ionizing radiation (such as X-rays) will be used. Also obvious is the requirement of very short detection time (about seconds), since the person under inspection will be free to move. It is also obvious, that false alarm rate must be very low, because the method will be applied to many people, where even 1% of false alarms will make operation practically impossible.

There are more difficulties, that are not so obvious – but may prove very hard to overcome in real application of any stand-off technology. For instance, any covert imaging of people may be unacceptable to public opinion, so that images generated will have to be made distorted or symbolic (but can be interpreted nevertheless). Another difficulty can arise from the fact that person carrying the explosive must be “tagged” somehow, and this must be done without his/her knowledge, so that appropriate security action can be done on a right person. For such “tagging” the method has very little time, since subject is moving and will go out of inspection area in seconds. One of the most serious difficulties for stand-off inspection is the fact that human operators cannot work efficiently for long periods of time. Their attention to the job will be impaired in several hours, and the efficiency of detection may be lost unless they have some prompt from automatic detection system. This can be avoided only if some autonomous computer analysis of detector signals (without human intervention) is added to any technology that will be used in the real field circumstances. In such case the computer will send alarm in all “suspicious” cases, and human operator will make decision (maybe using some additional data) whether this case should be handled by security enforcement personnel.

All these considerations must be taken into account when various technology proposals will be discussed in our workshop. Of course, some of the problems outlined above can be solved if we use several methods in combination, which usually increases selectivity and reliability of

detection and strongly reduces false alarm rate. There is another argument for using several methods in combination – such strategy can gradually improve when new methods are added to the system, especially when the system is based on visual surveillance and image recognition of people, when images of persons arousing suspicion are "tagged" in the computer systems, and when a person rated suspicious by several methods, maybe by several detectors, will gradually "stand out" in the data, accumulated by computer surveillance system. Such system may work in a large transport terminal (say, metro, railway station or airport) and accumulate data unobtrusively, while prompting operators when a "tagged" person is displayed on their screens. The computerized image recognition is improving dramatically day by day, computers are getting cheaper, faster, the software gets more "clever" – while physical signatures of explosives and detector sensitivities are not improving in the same proportion. We believe that new detection systems based on these principles have more chance of success in future, especially if new explosive compounds will appear in the field.