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An Airport-Passenger-Screening System based on Emitted IR and Thermal Radiation

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This paper discussed health issues related to passenger-screening-full-body scan (*backscatter-X-ray scan*), currently implemented at selected airports in Europe and North America, and proposed a safer system. In the full-body scan, X rays penetrate through clothes and Compton scattered to produce an unclothed image (which could be stored, although stated not to be stored during test runs) of the person being screened. Modern-image-processing systems can display this image as negative (looking like a body pattern) or positive (depicting the actual shape of face and body). In this process, it sets off millions of electrons on or near the skin. The scientific concerns arise from the fact that Compton scattering of X rays (ionizing radiation) generates a very large number of scattered electrons. They could disturb fluid-electrolyte balance of the body. Backscatter-X rays, not only, expose passengers, but also, security guards, who have to stand exposed for a whole shift of passengers. Depending on the geometry of the source producing them, they may fall off as inverse square (spherical symmetry) or inverse (cylindrical symmetry). These X rays are stated to be of low intensity and medium energy (the cross section of Compton scattering is maximum at medium energy). The *nature* of damage depends on the energy of the photons interacting with the surface. The *extent* of damage depends on the number of photons (intensity) interacting with the surface. The operational requirements of the process (detection of weapons concealed anywhere on the body surface) demand that private body parts of the image not be blurred using filters, because that would defeat the very purpose of scanning. For this very reason, there is no provision of shielding of gonads in the back-scatter-X-ray-screening system, which is a standard safety requirement in the clinical-X-ray procedures. Further, at some stage, the authorities managing the system would like to store the images for follow-up, investigation and evaluation of any security lapses discovered at a later stage as well as for research purposes. Hence, the statement that the images are destroyed after processing seems not to be compatible with standard security and surveillance procedures. Presently, data are not available on false positives. However, it seems that these would be almost as many as for security gates (or even more), because many things, which are harmless, may look like potential threat on screen (a pen may be mistaken as a pen pistol; an implant or an artificial body-part may prompt the screener to conduct an intrusive search). It has been pointed out that application of talcum powder on the skin may, also, produce false positives. As regards missed cases, the system would not be able to detect material, which has the same reflective properties as human skin, as well as objects hidden under thick clothes. Demetrius Klitou[¶] observes "Objects with a high atomic number (high-Z materials), such as metallic weapons, absorb X-rays, while explosives, containing, for example, nitrogen and carbon, which have a low atomic number (low-Z materials), scatter X-rays." Hence, there is an indication of blackout for intermediate-Z materials. In order to test the effectiveness of full-body-X-ray-backscatter-scanning system, a simulated-plastic explosive (a baggy with powdery substance) and a syringe were strapped to the body of a person, and had him go through the scanner. The scanner showed nothing except the needle and the unclothed figure of that person. The airline employee performing the *blind screening* missed both. Only metal shows white or very light gray. Hence, there seems to be no significant improvement over conventional security gates, except localization of the questionable object. Also, since it is a surface-analysis technique (like moiré fringe topography and rasterstereography), it would not detect explosives contained inside the body and in the body folds (radiation dose is kept low enough to skim the body surface) as well as other contraband. This type of screening poses highest risk to infants, children, elderly people, cancer patients and pregnant women (the first four have weak immune systems; as for the last group, radiation may inflict permanent damage to the unborn child) as well as frequent travelers and flight crews (the unnecessary radiation exposure of eyes and neck region — nobody covers eyes; it seems, extremely, strange to bombard the traveler's eyes with millions of vibrating electrons; similarly, interaction of radiation in the neck region may increase risk of thyroid cancer). Any wound or infection could, also, deteriorate from doses of radiation. *Active-millimeter-wave scanners*, look like not to be posing so many health hazards, although they can not be ruled out because of interaction of high-frequency radio waves with human body. The privacy issues are same as those in backscatter-X-ray scanners. Since very high-density materials, such as metals reflect more energy as compared to human flesh; this produces a 3-D image of the individual with surface detail of the body, at the same time indicating potential threats. An airport-passenger-screening system was proposed based on recording and display of infrared (IR) and thermal radiation emitted by a prospective traveler (similar to *passive-millimeter-wave scanner* developed elsewhere). It was stated that this system had the potential to detect explosives and controlled substances hidden in clothes, on the person or inside the body (surgically-implanted bombs), if IR and thermal imaging were combined with advanced signal- and image-processing techniques, canine teams and pat downs. Since there was no radiation, which was *given to* body (only the radiation *given out* by the body was examined), there seemed to be no significant health concern arising from this procedure. Being a passive scanner, the probability of damage to human body is, almost, negligible in case of malfunction. Such is not the case with active scanners (mainly, cheap systems bought by corrupt-third-world officials), *e. g.*, malfunctioning-iris-scanning system, *a serial-scanning device*, or defected-full-body-scanning system (both backscatter and millimeter wave), *a parallel-scanning device*, can, permanently, damage eyes. Such full-body systems, also, have the potential to burn skin and other organs, too. The un-researched health hazards of *active-scanning systems* and their potential to be converted into devices invading body privacy of a traveler are the prime reasons cited for the airline passengers to demand from screening authorities the model numbers, the specifications and the samples of outputs of such devices, so that they can record and document radiation exposure through security-screening devices, which use active-scanning processes (note that radiation doses add up from exposure-to-exposure, increasing cancer risk). Further, the prospective air travelers may be given the option to select *non-electronic systems* for security screening, if they so desire. The safe radiation limits must be declared clearly (medical exposure — no limit; occupational exposure — approximately, 20 *millisievert per year*; general public — approximately, 1 *millisievert per year*) in all public places. Passive exposure of general public through flying in an aircraft, *etc.*, must, also be accounted for. When there arises a doubt that authorities are not providing proper information, public must exercise constitutional right to self-monitor possible overexposure. Of course, it is against law, ethics and commonsense to hide such information from the tax-paying consumer. It, also, violates all norms of accountability and transparency. Security systems would become more efficient and highly effective if explosive-trace detection was coupled, not only, with passenger-identification systems based on previously proposed (by the speaker) static- and dynamic-3-D-face-recognition systems, gait recognition, biometric identifiers, but also, the study of psychological traits. These might include face reading (people have employed statistical methods to study temperature distribution of face) and checking whether a person was heavily influenced by persuasive individuals or ideologies (using, say, NN graphs).

Keywords: Backscatter-X-ray (full-body) scan • Compton scattering • Explosive-trace detection
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[¶]Klitou, D., "Backscatter body scanners – A strip search by other means", *Computer Law & Security Report*, Vol. 24, Issue 4, 2008, pp 316-325, p 317