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

This paper discusses 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 unclad 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 (resembling 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, also, on the intensity of the photons (on both the intensity of light and the area beyond the surface). The photons have to go through the skin and absorb X rays, which is expensive in terms of energy (e. g., 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-screening system, a simulated-plastic explosive (a baggy with powder 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 unclad figure of that person. The airline employee performing the blind screening missed both. One can imagine how many more would be less significant improvement over conventional security gates.

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, canname 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 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 scanner 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 body 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 Klitou1 observes “Objects with a high density compared to the body (hence 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. When there arises a doubt that authorities are not providing surveillance procedures. Presently, data are not available on false positives. However, it seems that there would be almost as many as for 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 for people with sensory deficits and flight crew tourists (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-scanner, looks 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 as those in backscatter-X-ray scanners. Since very high-density materials, such as metals reflect more energy away from human body; this is also valid for high-Z materials, such as metallic weapons, which 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-screening system, a simulated-plastic explosive (a baggy with powder 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 unclad figure of that person. The airline employee performing the blind screening missed both. One can imagine how many more would be less significant improvement over conventional security gates.

Backscatter-X-ray—like a body scan, or 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 surgery. Such is not the case with active scanners (mainly, cheap systems bought by corrupt-third-world officials, e. g., malfunctioning-ir-scanning system, a serial-scanning device, or detected-full-body-screening 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 unresearched health hazards of active-screening systems and their potential to be converted into devices invading body privacy of a traveler are the new area of concern. An active screening system obtained from the specifications and the sample of outputs of such devices, so that they can record and document radiation exposure through security-screening devices, which use active-screening 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. For example, — approximately, 1 millisievert per year — general public, the individual, — approximately, 20 millisievert per year; occupational exposure — approximately, 20 millisievert per year; occupational exposure — approximately, 20 millisievert per year. In all public places. Passive exposure of general public through flying in an aircraft, 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, 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, infra-red (IR), thermal radiation, explosive-trace detection

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