

## Short Report

# Body Scanners Based on Millimeter-Waves Technology

In the recent years, new technologies based on active sensors have been applied also for the measurement of the surface of the human body. In particular, by applying active millimeter-wave imaging technology onto the human body, it is possible to perform a whole body scan while the person remain fully clothed.

Active millimeter-wave imaging technologies operates as short-range radar (*radio detection and ranging*) systems. A millimeter-wave transceiver illuminates the human body with non-harmful ultra-high frequency radio waves. The radiation penetrates clothing and reflects off the body. The reflected signals are collected by the transceiver and analyzed by an image processing computer to reconstruct the data into images of the person.

The technology was originally developed by the U.S. Department of Energy's Pacific Northwest National Laboratory (PNNL) for screening people for security applications. In fact, the reflected signals can be analyzed to detect concealed objects made of any material. The company SafeView Inc. (a division of L-3 Communications Corp.) cooperated with PNNL for the commercialization of an entry portal based on this technology (see Figure 1 left). Additionally, cylindrical holographic imaging technology can be applied by acquiring data with a transceiver which rotates around the person. The combination of all the acquired data can result in a volumetric 3D model of the person (Figure 1 right), that can be analyzed at 360-degrees.



Fig. 1. Millimeter-wave imaging technology. From left to right: security entry portal SafeScout100 of SafeView; example of a clothed dummy and its millimeter-wave image showing a gun concealed under the clothing; image representation of 3D volumetric data of a real person.

The company Intellifit Corporation (USA) translated the same technology into a complete solution to extract 3D human body measurements for custom fit applications: the *Intellifit System*.

The Intellifit System applies the active millimeter-wave imaging technologies in a cylindrical holographic way, in order to perform a 360-degree whole body scan while the person remain fully clothed. The Intellifit System is composed of the 3D scanner based on the millimeter-waves technology and the accompanying image processing software.

The scanning process works in the following way: a person steps inside the Intellifit cabin without undressing, the "L" shaped millimeter-waves transceiver swings around and over the person to illuminate its body surface with millimeter-wave radiation and to collect the reflected signal (see Figure 2). The entire scanning process lasts about 10 seconds.

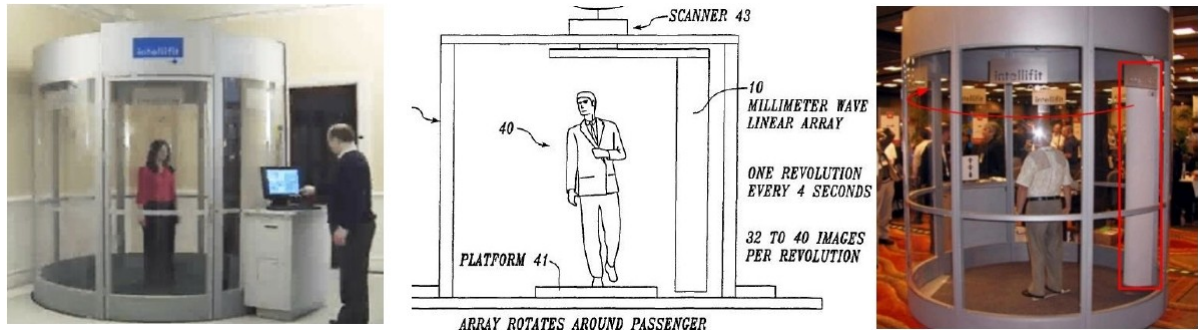


Fig. 2. Intellifit System. Right: the entire system with cabin and operating PC. Center: schema of the system. Left: the right box shows the L-shaped millimeter-waves transceiver that swings around the person.

The acquired data consists of two form: about 200,000 points in space, representing the surface of the human body (see Figure 3 left) and a volumetric representation of the person (see Figure 3 center). Out of the acquired data, automatic algorithms determine about 200 characteristic body measures of the person, such as the waist size, with an accuracy of about 6 mm. The results is presented as a print-out of the determined body measures (see Figure 3 right).

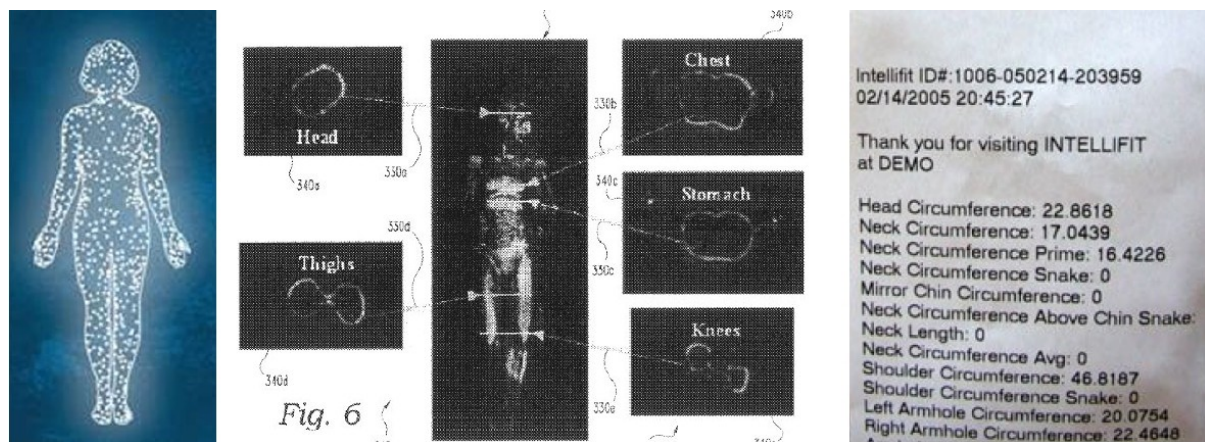


Fig. 3. Intellifit System. Left: collected data on the human body surface. Center: volumetric representation of the person and examples of some sections. Right: print-out of the system with human body measures.

For more detail about millimeter-wave technology applied to body scanning:  
 Hometrica Consulting - Dr. Nicola D'Apuzzo, Switzerland, [www.hometrica.ch](http://www.hometrica.ch)