

2.16. NON-DESTRUCTIVE TESTING WITH MICRO- AND MM-WAVES-WHERE WE ARE-WHERE WE GO

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Electromagnetic Waves covering the wavelength range from decimetre down to millimetre (in vacuum, frequencies from 300 MHz up to 300 GHz) are called micro and mm waves. As these waves can penetrate non-electrically-conductive materials in NDT they are especially suitable for testing of paper, wood, ceramics, concrete, polymeric materials and fibre composites too, mainly when the fibres involved are non-conductive. Insofar humidity plays not an important role the wave can penetrate also clothing to a certain amount which makes the waves in the last years also popular for detecting of concealed weapons or explosives in security applications.

The contribution describes the basic physical interaction of these waves with objects for their detection and characterization based on phenomena like reflection and scattering similar to the propagation of ultrasound in solid state materials. Practical examples are given to profiling of humidity in porous material and to monitor injection moulding of polymers. Special emphasis [1] is laid on the imaging of concealed objects under clothing and the problem to quickly but reliably detect weapons and explosives by scanning persons and using imaging algorithms like SAFT (synthetic aperture focusing technique) and pattern recognition procedures. Especially the characterization of the explosive materials ask for a multi-sensor concept, based not alone on the micro and mm wave interaction but also on an infrared spectroscopic application where all of the data are combined by data fusion algorithms in one image for evaluation. Fig. 1 below, presents the visualization of a revolver hidden under a coat by utilizing SAFT and a 94 GHz mm wave radiation transmitted by a RADAR-module, shown in fig. 2, which is a Fraunhofer-IAF development.



Fig. 1. Visualisation of a hidden revolver

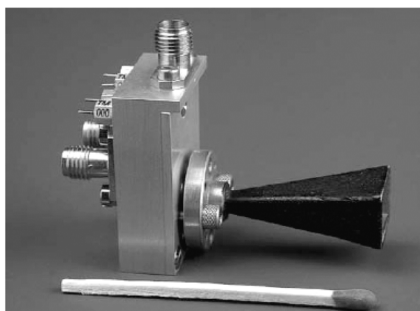


Fig. 2. 94 GHz RADAR-module

References:

1. **Dobmann, G.** et al. Standoff Detection of Dangerous and Illegal Objects and Substances Concealed Beneath Clothes on the Basis of Electromagnetic Centimetre- and Millimetre Waves and Electronic Nose; in the Proceedings of the Security Research Conference "Future Security"; 2, 12.-14.09.2007, Karlsruhe, Germany. – P. 112 – 116.