

Radio sweat gland — 90 GHz

Sweat ducts in human skin act like an array of tiny antennas that pick up radiation at specific frequencies, according to researchers. The finding might one day be used in medical and security technologies to assess a person's mental state from a distance.

A team of researchers in Israel has shown that sweat ducts pick up radiation at frequencies of about 100 gigahertz — the so-called extremely high frequency or EHF range, lying between microwaves and terahertz radiation. The antenna behaviour is all down to the ducts' curious shape: they thread through the epidermis as regular helices. Filled with electrically conductive sweat, these channels act rather like coils of wire that absorb radiation across the millimetre and sub-millimetre wavelength band.

Yuri Feldman of the Hebrew University of Jerusalem and his colleagues directed a beam of EHF radiation onto the skin of the palms of subjects who had been jogging for 20 minutes, and measured the radiation that was reflected back.

They found a strong band of absorption that was not seen before exercise. This absorption gradually disappeared as the subjects rested after jogging (Y. Feldman *et al. Phys. Rev. Lett.* **100**, 128102; 2008). The researchers also found that the reflection signals were proportional to blood pressure and pulse rate — known indicators of physiological stress leading to sweating.

And when the researchers suppressed palm sweating with a synthetic compound that mimics the paralysis of snake venom, inactivating the sweat glands, they found that EHF absorption during exercise was markedly reduced.

The helical antenna array makes skin a kind of biological metamaterial, Feldman's group says, in which the material's response to electromagnetic radiation is determined by structure rather than composition. Metamaterials made from arrays of tiny electrical circuits are being explored for applications ranging from super-lenses to invisibility shields. "Nature has done what is being attempted extensively today

in nanophotonics," Feldman says. "This effect might be used for biomedical and homeland-security applications."

Sweating hands have been used in lie detection, but using physiological parameters in 'polygraph' lie detectors is controversial and was strongly criticized in a 2002 report by the US National Academy of Sciences. "Perspiration is related to increases in emotional arousal," says Paul Ekman, a psychologist in Oakland, California, and an author of the academy's report. But he adds that "it can be the consequence of many different mental processes" — not only lying.

So far, Feldman and his colleagues are cautious about whether the idea will work at all, let alone how it might be applied. For example, they need to find the distance at which a meaningful signal can be detected and how long it takes for the signal to register changes in the biometric parameters. "We are just starting our journey in these uncharted waters," says Feldman. ■

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