Small, low-noise oscillator may help in surveillance

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A new design for a microwave oscillator that is smaller, simpler, and produces clearer signals at a single frequency than comparable devices has been invented at the National Institute of Standards and Technology (NIST).

Applications could include homeland security (e.g., surveillance of radio traffic for anomalous signals, or high-resolution digital imaging radar on unmanned aircraft), telecommunications (e.g., maintaining separation between frequencies in high-bandwidth networks), and perhaps even consumer devices (e.g., satellite television downlinks).

A patent was issued recently* for the NIST oscillator, which is about the size of a roll of 35 mm camera film. NIST researchers have built five prototypes on test fixtures, which offer several-orders-of-magnitude reductions in various types of self-generated signal interference, or noise, compared to typical commercial oscillators, resulting in improved frequency stability, according to David Howe, one of the inventors. In addition, the simple design reduces costs and improves reliability, while consuming less power than other oscillators of comparable signal purity. The small size could be an advantage on some surveillance platforms.

Microwave oscillators are used as reference or clock signals in many high-precision technologies. Through control of temperature and other variables, the oscillators produce a desired signal at one narrowly defined frequency while suppressing random, electronically induced "noise" generated by components. In the best microwave oscillators, the signal

typically is amplified inside a metal cavity containing a solid insulating material that internally sustains microwaves and radio waves with minimal loss, especially at cryogenic temperatures, an expensive and complex design. By contrast, the NIST oscillator uses an ultra-stiff ceramic manifold that supports a single frequency with either a vacuum or air as the insulating medium.

The NIST device operates at high signal power (many watts) without the noise penalty found in the conventional design just described. The technique maintains such a stable frequency that it can overcome or compensate for self-generated noise produced by components such as amplifiers that sustain oscillation. NIST researchers continue to work on improvements, hoping to make the technology more tolerant of vibrations such as those from aircraft, field radars, and even sub-audible vibrations in buildings.

Source: NIST