Terahertz Gap Communication Using Black Body Radiation

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The most significant remaining frontier of radio encompasses the band of frequencies from 300 GHz to above 30 THz, known as the terahertz (THz) gap. This range is too high to generate with semiconductors and too low to generate with optics. The best THz signal generation method uses black body radiators; any object with greater than zero Kelvin temperature emits electromagnetic radiation. Current black body radiation based THz communication devices transmit information extremely slowly; this project aims to reach data rates faster than current devices. The transmitter uses a metal ceramic heater (MCH) at 570 K, emitting around 30 THz peak. Electrical modulation is impossible because black body radiators are heaters with significant rise and fall time. Instead, mechanical modulation (MM) uses a motor to move an opaque object into the beam to control data transmission. The receiver uses a pyroelectric sensor to detect incoming data, while a high-density polyethylene filter reduces incoming noise. A microcontroller regulates the modulator and logs receiver data. At one meter, Stage 1 achieved a data rate of .5 bps, three times that of any previous black body radiator device, and a signal-to-noise ratio of 11 dB. Stage 2 increased the modulator speed and receiver sample rate and can achieve 10 bps, 20 times that of Stage 1. Future work includes replacing the receiving sensor for a higher sample rate and adding a field-of-view limiter to reduce noise. This device provides a basis for further experimentation in the THz gap.

Awards Won:

National Security Agency Research Directorate : Second Place Award “Principles of Security and Privacy”