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Recent development of terahertz wave sensing and imaging science, technology, and applications

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Recent advances in THz science and technology make it one of the most promising research areas in the 21st century for sensing and imaging, as well as in other interdisciplinary fields. We believe new T-ray capabilities will impact a range of interdisciplinary fields and industrial companies, including: communications, imaging, medical diagnosis, health monitoring, environmental control, and chemical and biological identification. While microwave and X-ray imaging modalities produce density pictures, T-ray imaging provides spectroscopic information within the THz frequency range. The unique rotational and vibrational responses of materials within the THz range provide information that is generally absent in optical, X-ray and NMR images. A THz wave can easily penetrate and inspect the insides of most dielectric materials, which are opaque to visible light and low contrast to X-rays, making T-rays a useful complementary imaging source in this context. Recent developments of THz wave technologies allow us to coherently control a THz wave (phase, amplitude, and directionality). I present its impacts the physics understanding and industrial applications. Examples of imaging a long distance target (>100 meters), large scale industrial samples (>m2), or a small scale semiconductor device (a few nanometer) will be presented.