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CMOS based terahertz instrumentation for imaging and spectroscopy

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Terahertz imaging and spectroscopy based on optical and electronic generation and detection of radiation has resulted in a wealth of new application opportunities in the area of medical surgery (e.g. tumor margin detection), biomedical analysis (e.g. protein interaction), non-destructive testing (e.g. production control), security (e.g. airport scanners, detection of concealed weapons) as well as in fundamental research (e.g. astronomy, solid state physics).
Many applications require the miniaturization of the spectroscopic imaging system in order to enable their co-integration with other devices, ultimately leading to terahertz integration in mobile applications.
The scientific community has engaged in this integration strategy by an increased amount of research on room temperature CMOS based circuits in the frequency range up to about 1 Terahertz.
This keynote will give an overview about the state of the art of terahertz circuits in CMOS and show the link to key applications accessible for electronic room temperature systems.
The terahertz frequency range is extremely challenging for CMOS technology, as it is beyond the traditional transistor operating frequencies fT and fMax. The keynote will describe which new components and circuit design techniques have been developed for terahertz sources and receivers. An overview about state-of the art instrumentation of terahertz imaging and spectroscopy will be presented. In more detail an extremely broadband transmitter-receiver system will be described, that was developed in the FP 7 project ULTRA. It is composed of a transmitter and receiver, both based on nonlinear transmission line generators operating in the frequency range up to 500 GHz. The system overview, high speed Schottky diode design, transmitter and receiver circuitry, broadband antenna development and modular integration will be presented. A comparison between this CMOS based system and optical terahertz time domain spectroscopy will be given.
The keynote will conclude with a vision about the requirements of future terahertz systems in order to open the discussion for new collaborations.

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Session Classification: Plenary