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THz Phase Extraction Algorithms for a THz Modulating Interferometric Doppler Radar

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Abstract : Various THz phase extraction algorithms have been developed for a novel THz Modulating Interferometric Doppler Radar (THz-MIDR) developed recently by the author. The THz-MIDR differs from the well-known FTIR technique in that it introduces a continuously modulating reference branch, compared to the time-consuming discrete FTIR stepping reference branch. Such change allows real-time tracking of a moving object and capturing of its Doppler signature. The working principle of the THz-MIDR is similar to the FTIR technique: the incoming THz emission from the scene is split by a beam splitter/combiner; one of the beams is continuously modulated by a vibrating mirror or phase modulator and the other split beam is reflected by a reflection mirror; finally both the modulated reference beam and reflected beam are combined by the same beam splitter/combiner and detected by a THz intensity detector (for example, a pyroelectric detector). In order to extract THz phase from the single intensity measurement signal, we have derived rigorous mathematical formulas for 3 Frequency Banded (FB) signals: 1) DC Low-Frequency Banded (LFB) signal; 2) Fundamental Frequency Banded (FFB) signal; and 3) Harmonic Frequency Banded (HFB) signal. The THz phase extraction algorithms are then developed based combinations of 2 or all of these 3 FB signals with efficient algorithms such as Levenberg-Marquardt nonlinear fitting algorithm. Numerical simulation has also been performed in Matlab with simulated THz-MIDR interferometric signal of various Signal to Noise Ratio (SNR) to verify the algorithms.

Keywords : algorithm, modulation, THz phase, THz interferometry doppler radar
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