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A high-precision terahertz retrodirective antenna array with navigation signal at a different frequency

Key words: Terahertz; Retrodirective antenna array; Terahertz communications; Conjugate mixing

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Motivation

1. Future communications will provide higher transmission rates and higher operating frequencies. Due to the very high working frequency, it is impossible to realize a wide beam coverage, meaning that agile beam tracking will be an inevitable trend in technology development.

2. Traditional beam tracking needs to cooperate with the beam direction detection system in communication, and needs additional baseband processing resources.

3. At present, it is a great challenge to detect the DOA (direction of angle) in the terahertz band.

Main idea

1. The beam retrodirective communication can complete the alignment communication without detecting the DOA of the beam from the other end of the communication system.

2. The traditional beam retrodirective technology uses conjugate mixing with local oscillators at a frequency of two times that of the carrier frequency. It will be a problem in the terahertz band to realize a double frequency signal.

3. Due to the short wavelength of terahertz wave, the structure of the retrodirective antenna array must have a compact architecture.

Method

1. A high-precision terahertz retrodirective antenna array with the navigation signal at a different frequency is proposed and successfully designed.

2. The method of high and low frequencies twice mixing is adopted to avoid the conjugated mixing of the double frequencies of local oscillators.

3. A three-dimensional stacked sandwich structure is proposed for the structural form of the beam backtracking antenna array.

Major results

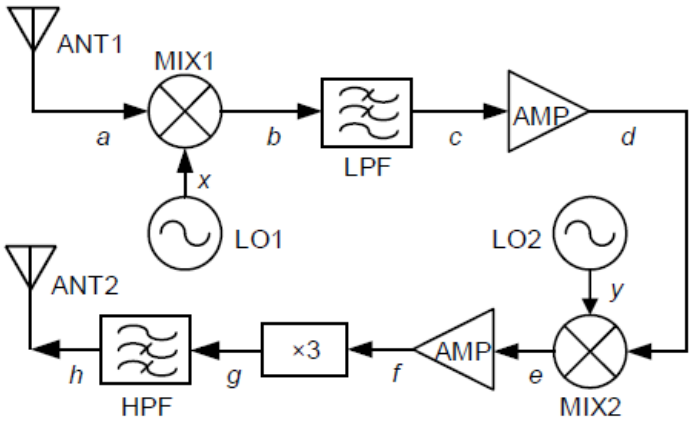

Fig. 2 Block diagram of receiving and transmitting links in a single channel

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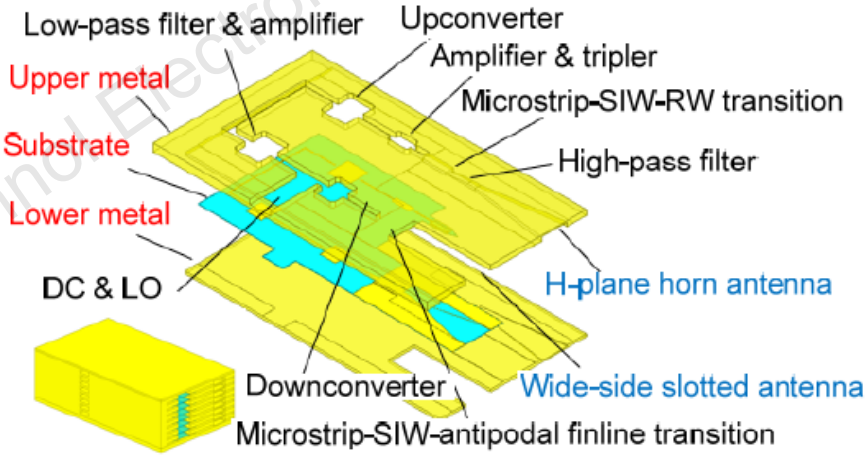

Fig. 3 Sketch of the proposed stacked sandwich structure and stacked sandwich in a single channel in details for a 120-GHz received antenna array

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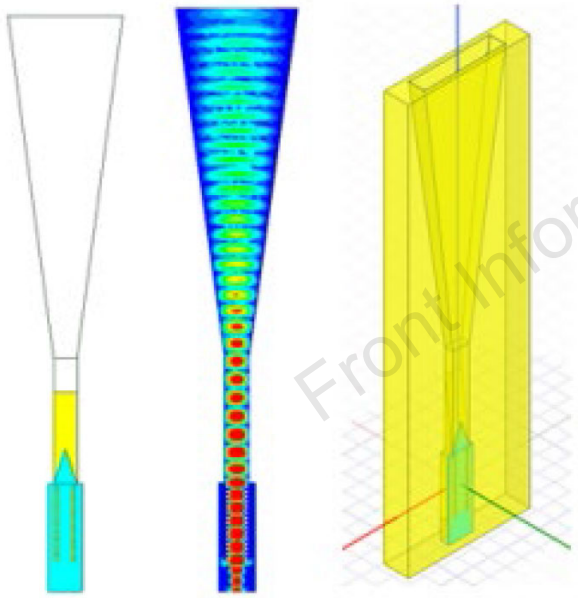
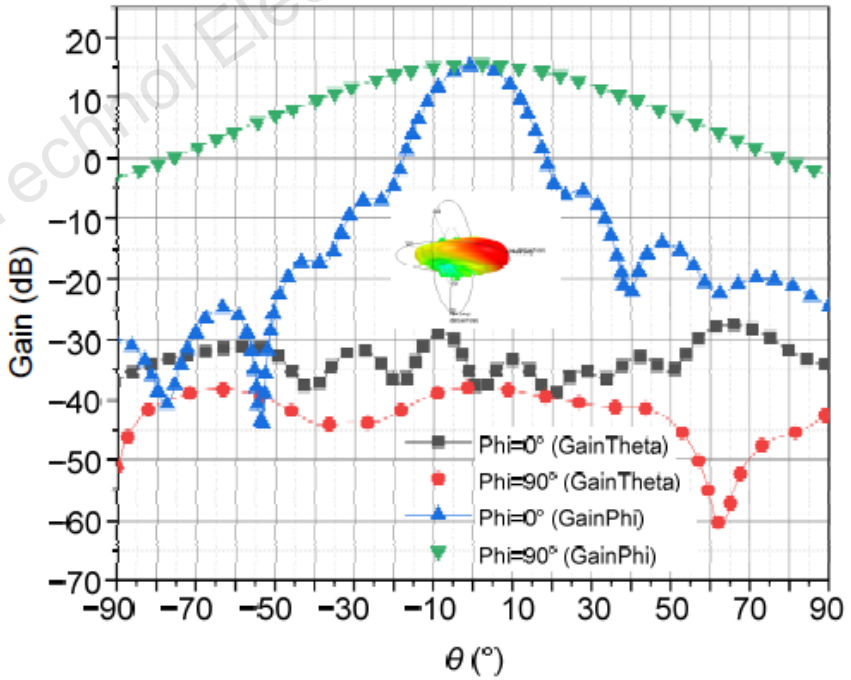
Major results (Cont'd)

1. Structure of the 120-GHz antenna element and simulation results of the array





Major results (Cont'd)

2. Results of the 40-GHz receiving antenna array

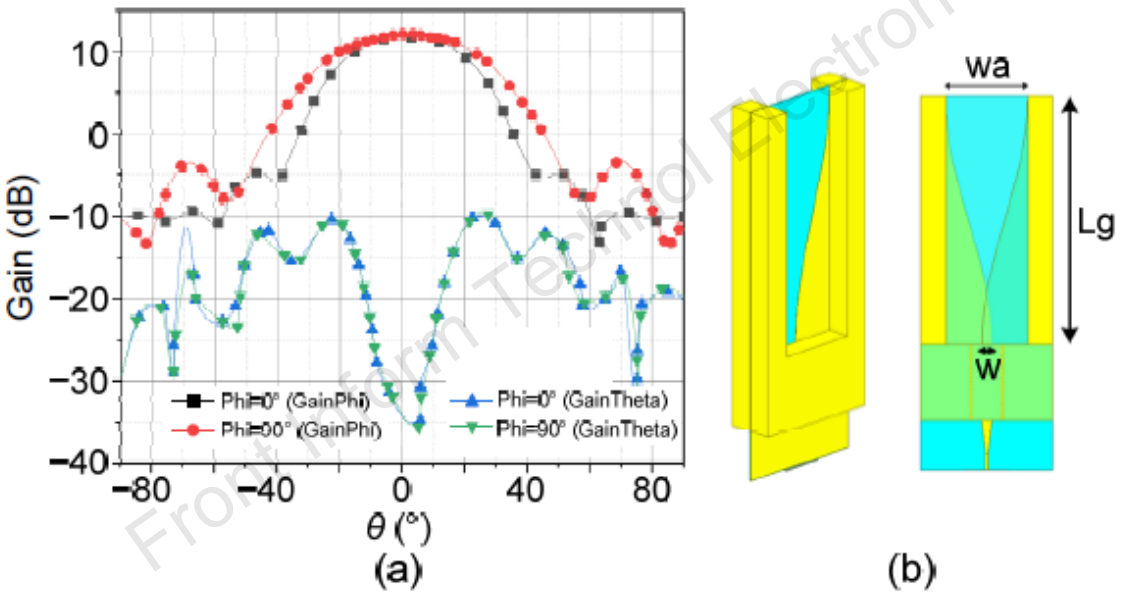


Fig. 6 Simulation result (a) and stacked sandwich in a single channel (b) for a 40-GHz receiving antenna array

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Major results (Cont'd)

3. Scanning radiation pattern of the retrodirective array

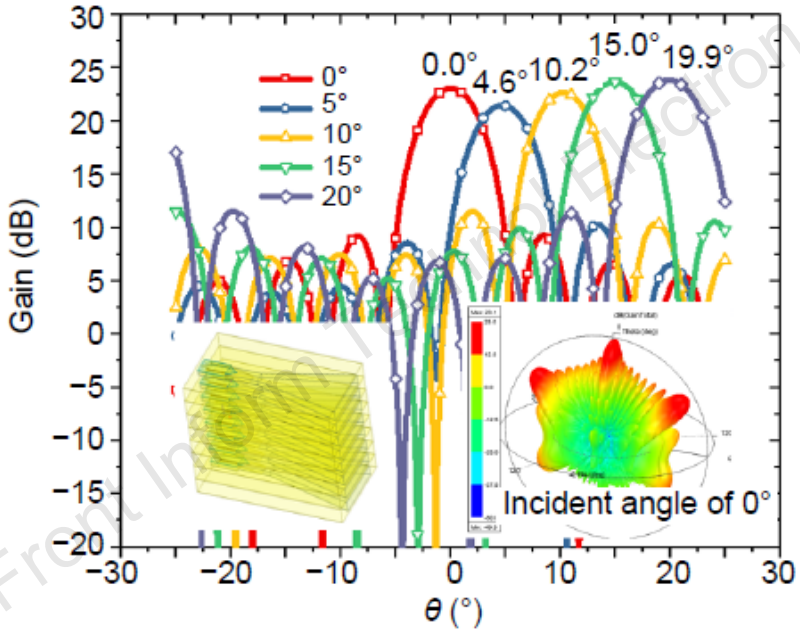

Fig. 10 Scanning radiation pattern of the retrodirective array versus different incident angles

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Conclusions

1. The retrodirective array for terahertz tracking has been designed and verified in simulations.

2. This array has been developed and received a 40-GHz navigation signal and retransmitted a 120-GHz beam in the direction of the arrival wave.

3. Simulation results indicated that the proposed array with the stacked sandwich structure can realize the tracking of the arrival wave.