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香港城市大學
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Space-Time-Coding Metasurfaces for 6G Communications

Communications & Information

Consumer Electronics

Digital Broadcasting, Telecommunication and Optoelectronics

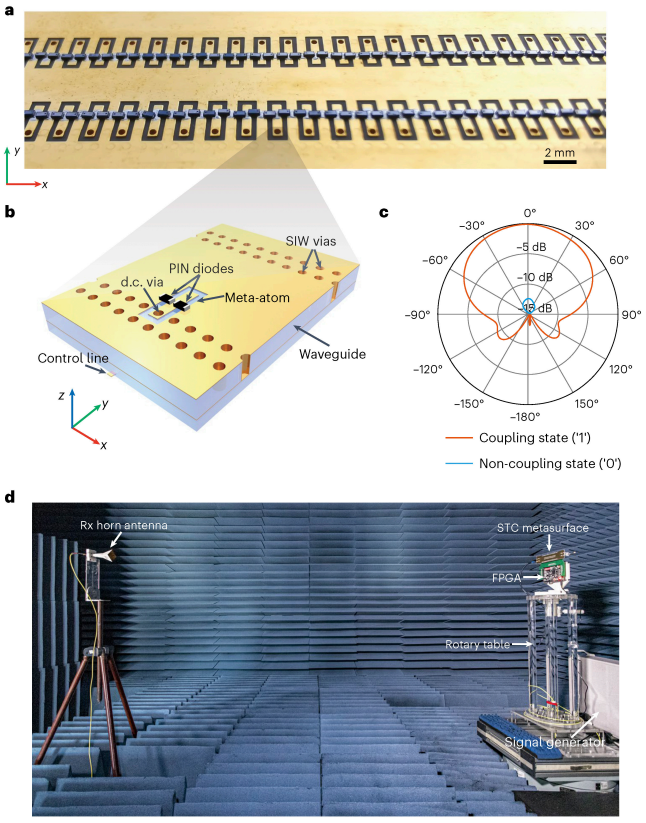

Fig. 6 | Prototype design, modelling and characterization. a, Photograph of the fabricated STC metasurface antenna prototype. **b**, Configuration of the SIW-based meta-atom. PIN diodes, controlled by the FPGA, are incorporated into each meta-atom to switch the element between the coupling and non-coupling states. **c**, Simulated radiation patterns of the meta-atom in the coupling ('1') and non-coupling ('0') states. **d**, Measurement setup of the STC metasurface antenna in a microwave anechoic chamber.

Remarks

1. International Exhibition of Inventions of Geneva (IEIG) 2024 - Gold Medals with Congratulations of the Jury

IP Status

Patent granted

Technology Readiness Level (TRL) ? 6

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Opportunity

While the global commercialization of fifth-generation (5G) wireless communications is gradually taking off, there is already significant interest in the next generation of wireless communications. 6G scheduled to be launched in 2030, will provide a Tbps data rate, microsecond latency, and almost unlimited bandwidth to the connectivity of numerous mobile and intelligent networks. Antennas and metasurfaces are ubiquitous and indispensable components to generate and manipulate electromagnetic (EM) waves. This invention is a novel space-time coding metasurface antenna (STCMA) that can control all fundamental properties of EM waves in a software manner, including amplitude, phase, frequency, direction, and polarization. The STCMA features the advantages of unprecedented wave and information manipulation capability, straightforward coding strategy (1-bit), and potential on-chip integration compared with conventional antennas, making it an appealing antenna solution for B5G and 6G communications.

Technology

The invention is a novel spatiotemporally modulated metasurface antenna that combines spatiotemporal modulation technology and leaky-wave antenna technology. The metasurface antenna consists of an array of high-speed RF switches on the top of a waveguide structure to extract the energy from the waveguide to free space. By controlling when, where, and how long the switches on the meta-atom are turned on, we can dictate the magnitude and phase of the electric field distribution at the antenna aperture. Therefore, the radiation characteristics of the antenna, including amplitude, phase, polarization, frequency, and direction, can all be flexibly manipulated and agilely altered by the software control. Additionally, the metasurface antenna can function as a transmitter capable of directly generating modulated waveforms. This design offers distinct advantages over conventional transmitter architectures, providing a simpler structure while enhancing security against eavesdropping. Incorporating with an external super-resolution lens, we can perform real-time imaging with sub-wavelength resolution.

Advantages

- Powerful wave manipulation
- High security
- High integration
- Low power consumption
- Potential on-chip integration

Applications

- B5G and 6G wireless communications
- Detection and imaging
- Noncontact sensing
- RFID system
- Wireless power transfer