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A compact ultra-wideband crossed-dipole antenna for 2G/3G/4G/IMT/5G customer premise equipment applications

Key words: 5G; Crossed dipole; Dual polarization antenna; Terminal antenna; Ultra wideband

Jingli GUO, Lun CUI
E-mail: guojl@xidian.edu.cn; ID_CLXX@163.com
ORCID: Jingli GUO, https://orcid.org/0000-0002-4515-8165;
Lun CUI, https://orcid.org/0000-0002-4575-8064

Motivation

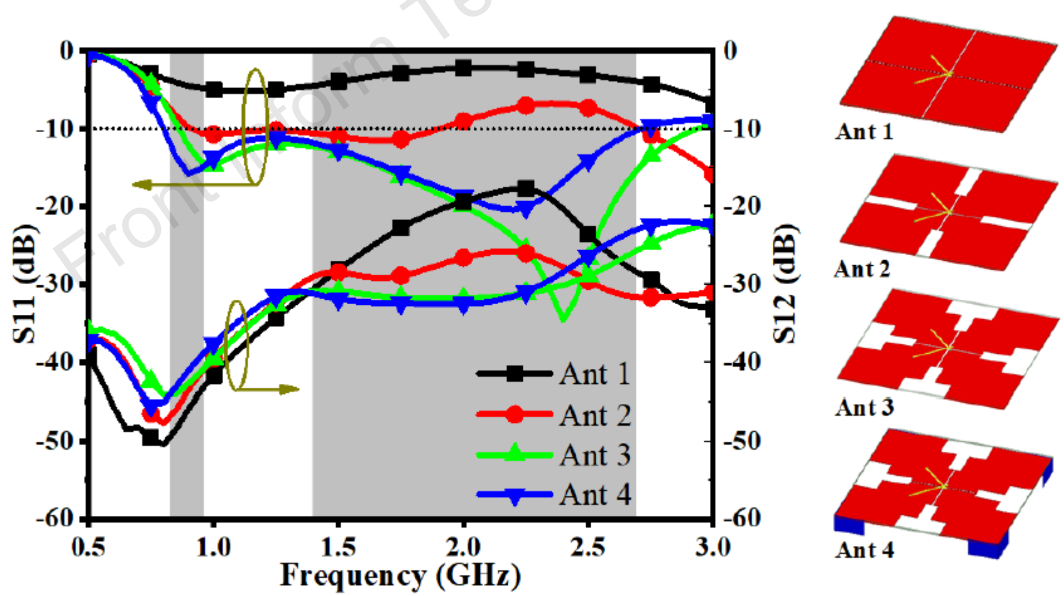
- The booming development of fifth-generation (5G) technology provides a huge opportunity for Internet of Things (IoT), which can realize device-to-device (D2D) communication.
- To realize interconnection across various intellectual equipment, a relay is always required to realize D2D communication in practice.
- As the assignment of 5G sub-6 GHz spectrum is various among different countries (e.g., China: 3.4–3.6 and 4.8–5 GHz; Europe: 3.4–3.8 GHz) and the existing 2G/3G/4G/IMT system will still work in many regions for a long time, it is necessary to design wideband antennas that could cover 2G/3G/4G/IMT and 5G spectra to support global large-scale 5G commercial use.

Main idea

- Crossed dipole antennas are widely adopted in terms of advanced transmission characteristics: they are superior in reducing the multi-path fading, and the channel capacity can be doubled compared with the case where only one polarization is considered.
- Adding a parasitic element is widely used to enhance the bandwidths of crossed dipole antennas.

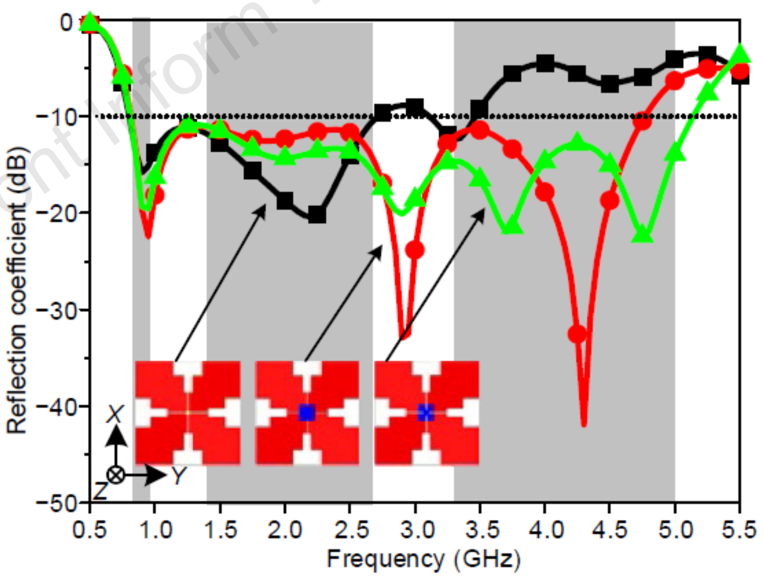
Method

The arms of the crossed-dipole antenna are formed by step-shaped patches, and a wideband operation can be realized by properly selecting the order of the step-shaped patches; its bandwidth can be further enhanced by extending the end of crossed dipole downward. Each dipole is excited by a microstrip stub that is directly connected to a coaxial cable.



Method (Cont'd)

A square parasitic patch is first added beneath the crossed dipoles. The implementation of the parasitic patch greatly improves the matching in 3 and 4.3 GHz. Further, by etching four slots on the parasitic patch along the gap between dipoles, another resonance is activated and 5 GHz band can be fully covered for reflection coefficients lower than −10 dB.



Method (Cont'd)

The simulated surface current distribution at 3700 and 4800 MHz of parasitic patch with and without slot are presented in Fig. 6.

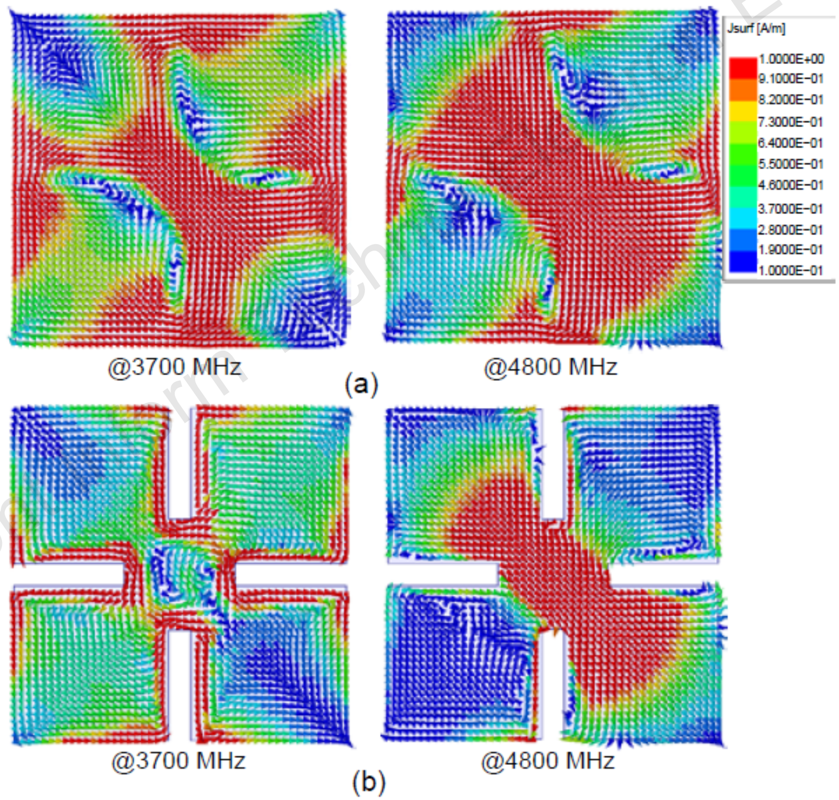
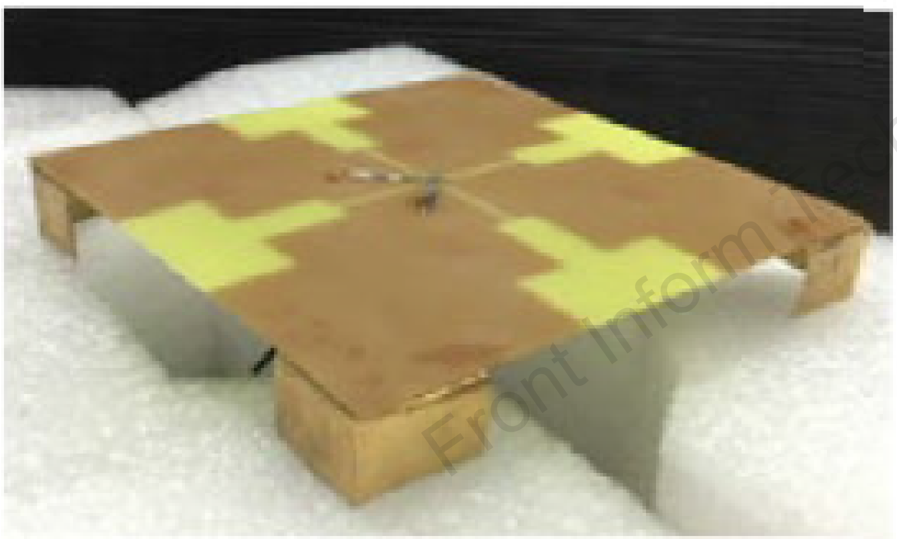
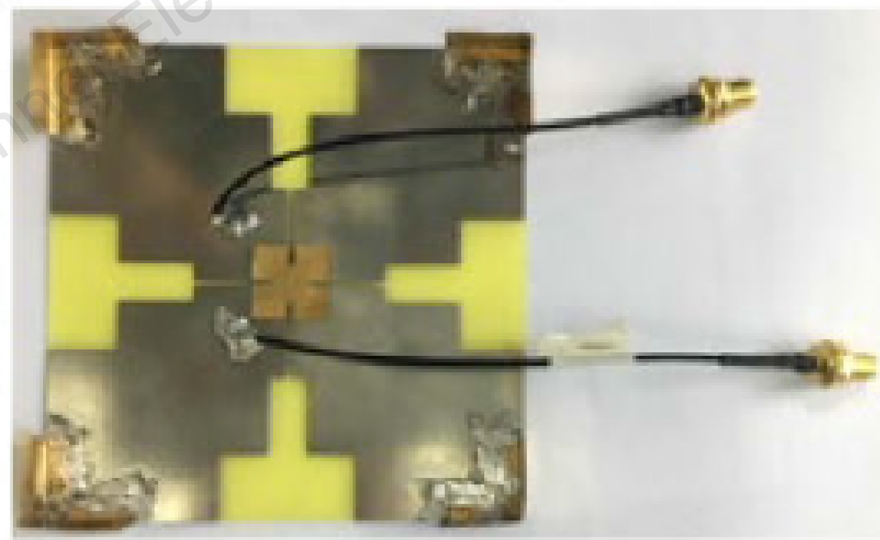


Fig. 6 Simulated surface current distribution at 3700 and 4800 MHz when P1 is excited: (a) parasitic patch without slot; (b) parasitic patch with slot

Major results

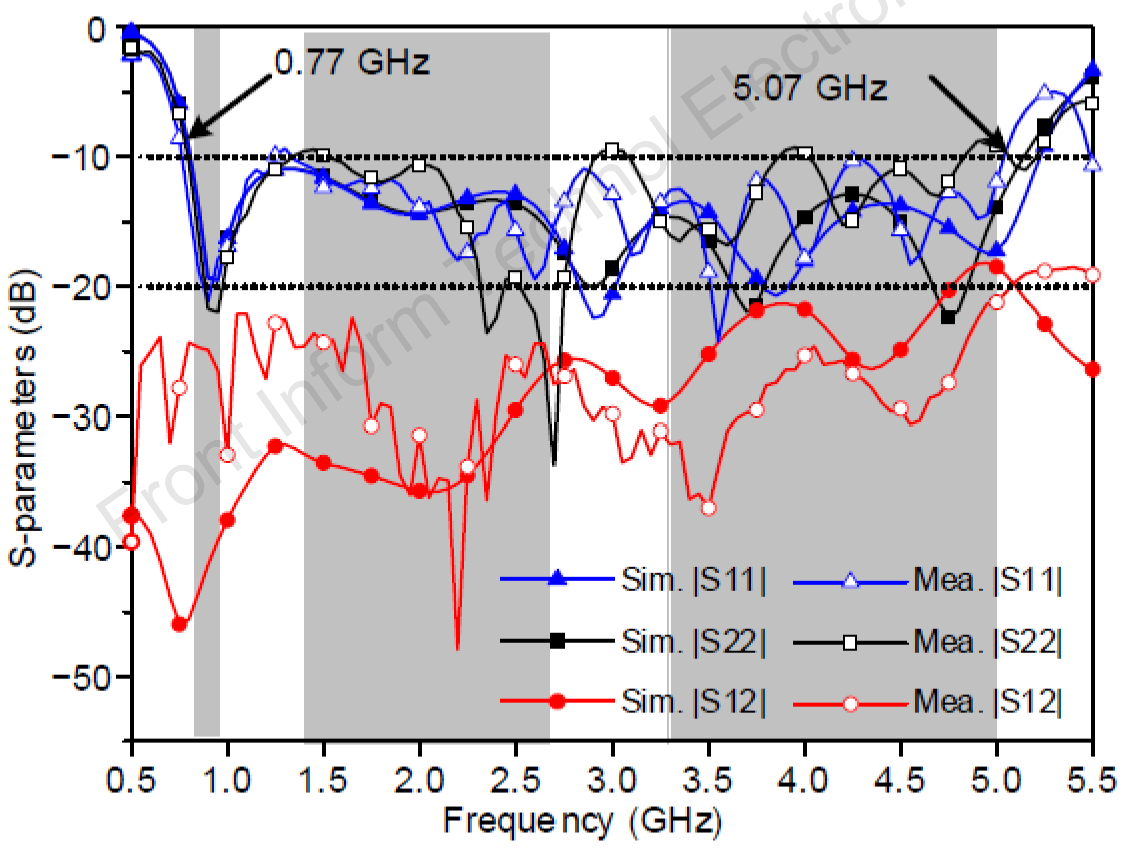
Prototype of the proposed antenna





Major results (Cont'd)

Simulated and measured *S*-parameters



Conclusions

The measurement results showed that the proposed antenna could cover 2G/3G/4G/IMT/5G bands with a bandwidth of 147.3% (0.77–5.07 GHz) for return loss lower than 10 dB, and that the isolation between two ports was higher than 20 dB; also, a stable radiation pattern was achieved.

Table 1 Comparison between the proposed and referenced antennas

Reference	λ_L	Bandwidth	Isolation (dB)	Antenna structure
Wu et al., 2018	0.62×0.62×0.17	65.1% (1.40–2.75 GHz, 15 dB)	>30	Complex (10 parasitic patches)
	0.32×0.32 (planar)	63.0% (1.40–2.70 GHz, 15 dB)	>30	Simple (one parasitic patch)
Zhang YH et al., 2019	0.28×0.28 (planar)	91.8% (2.38–6.42 GHz, 10 dB)	>30	Simple
	0.28×0.28 (planar)	75.0% (1.68–3.7 GHz, 14 dB)	>30	
Alieldin et al., 2018	0.35×0.35 (planar)	31.3% (0.70–0.96 GHz, 10 dB); 55.3% (1.70–3.00 GHz, 10 dB); 14.0% (3.30–3.80 GHz, 10 dB)	>20	Simple
This paper	**0.24×0.24×0.03**	**147.3% (0.77–5.07 GHz, 10 dB)**	**>20**	**Simple (one parasitic patch)**

λ_L represents the free-space wavelength at the lowest operating frequency, and the unit is mm×mm or mm×mm×mm