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5G evolution promoting innovation of antenna systems

Key words: Fifth generation (5G); Massive multiple-input multiple-output (MIMO) antenna array; Power consumption; Weight optimization

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Motivation

1. To achieve 1000 times capacity gain and 10 Gb/s of speed in 5G, massive MIMO antenna systems have become the key in wireless systems.

2. Describe the requirements for 5G networking and optimization of antenna systems.

3. Present weight optimization methods of massive multiple-input multiple-output (MIMO) antennas.

4. Solve the problem of power consumption of 5G antenna systems.

Main idea

1. By the time when 5G encoding and decoding processes would reach a capacity limit, antenna systems would be a key for improving the capacity of 5G networks.

2. An intelligently optimized method is needed to realize artificial intelligence (AI) optimization for the 5G network.

3. All the proposed algorithms are validated by simulations.

Method

1. Weight optimization methods of massive MIMO antennas are proposed and verified.

2. According to the user equipment (UE) distribution in different scenarios, the antenna weight self-optimizing configuration can be adjusted dynamically to replace part of the work of traditional manual network planning and optimization.

Method (Cont'd)

3. Beam parameter optimization includes weight initialization and weight optimization.

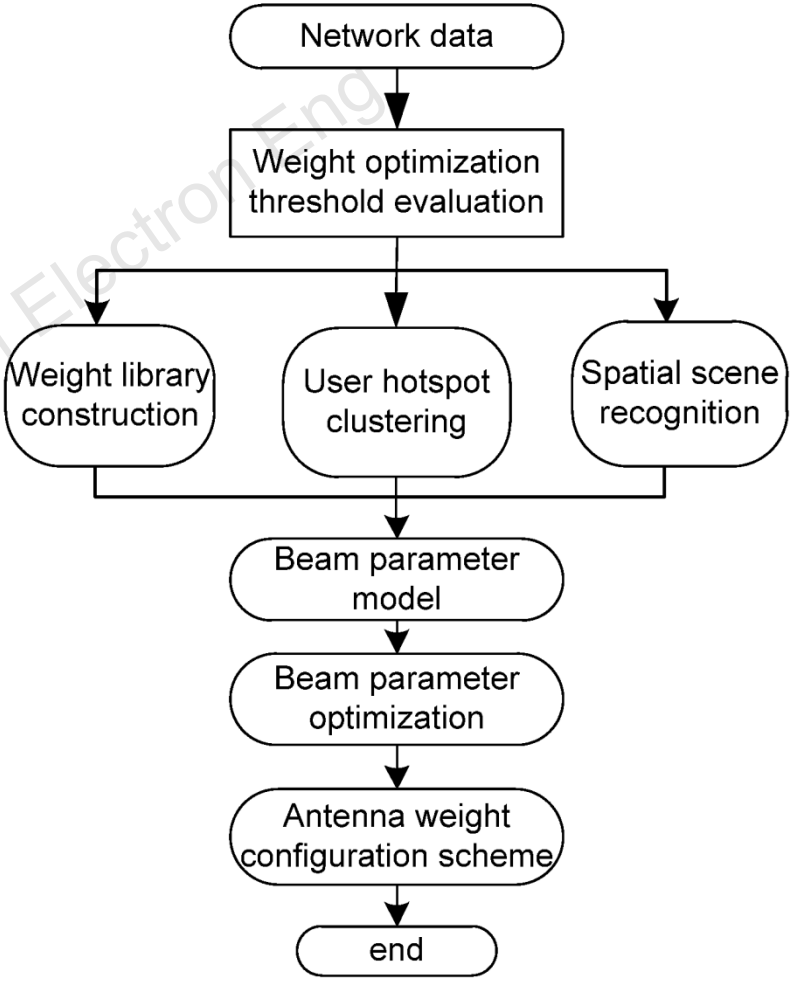

Fig. 7 Weight optimization flowchart

Major results

Table 1 Broadcast beam patterns in different scenarios

Pattern	Horizontal HPBW (°)	Vertical HPBW (°)	Azimuth (°)	Digital beam tilt (°)	Application scenario
1	65	6	[−10, +10]	[−3, +12]	Standard macro coverage and low-floor coverage
2	65	12	[−10, +10]	[−3, +12]	Standard macro coverage and middle-floor coverage
3	65	25	[−10, +10]	[+9, +12]	Standard macro coverage and high-floor coverage
4	45	12	[−20, +20]	[−3, +12]	Middle buildings and hotspot coverage
5	45	25	[−20, +20]	[+9, +12]	High buildings and hotspot coverage
6	30	25	[−30, +30]	[+9, +12]	High buildings and hotspot coverage
7	15	25	[−40, +40]	[+9, +12]	High buildings and hotspot coverage
8	90	6	0	[−3, +12]	Standard macro coverage and low-floor coverage
9	90	12	0	[−3, +12]	Standard macro coverage and middle-floor coverage
10	90	25	0	[+9, +12]	Standard macro coverage and high-floor coverage

HPBW: half power beam width

Major results (Cont'd)

Table 2 Different configurations of broadcast channel narrow beams

Broadcast beam	subBeam index	Azimuth (°)	Downtilt (°)	Horizontal HPBW (°)	Vertical HPBW (°)
Single beam	1	0	6	65	6
Four beams	0	−27	6	20	6
	1	−9	6	20	6
	2	9	6	20	6
	3	27	6	20	6
Eight beams	0	−29	6	16	6
	1	−20	6	10	6
	2	−12	6	10	6
	3	−4	6	10	6
	4	4	6	10	6
	5	12	6	10	6
	6	20	6	10	6
	7	29	6	16	6

HPBW: half power beam width

Major results (Cont'd)

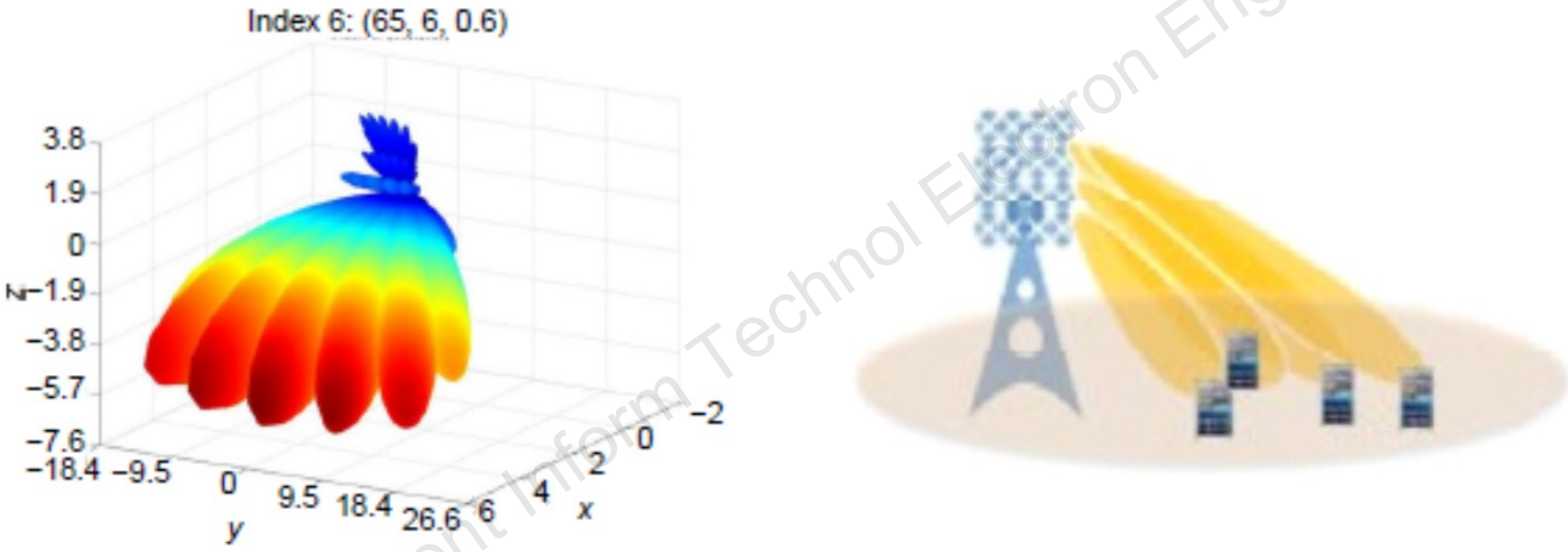

Fig. 5 New radio broadcast beams in square scenarios

Major results (Cont'd)

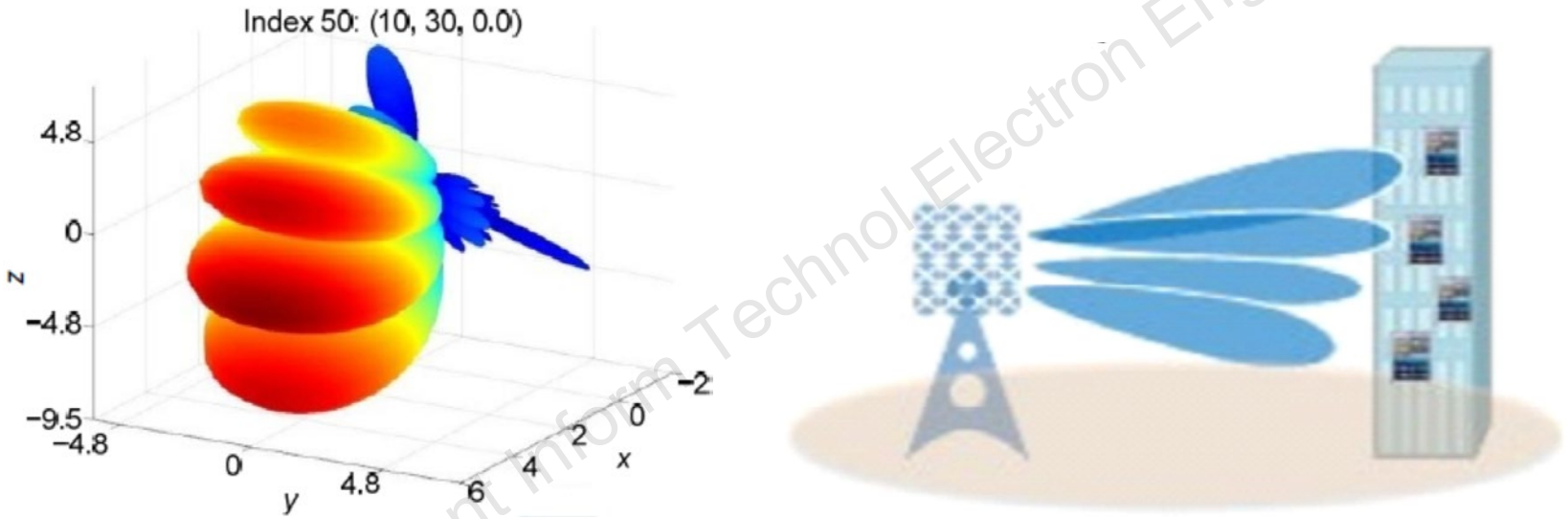

Fig. 6 New radio broadcast beams in high-rise buildings

Conclusions

1. The AAU solution has been presented, and the basic principle and related theory of the 3D antenna array have been elaborated in detail.

2. New requirements of 5G mobile communication system networking and optimization for the antenna system have been recommended.

3. Weight optimization would be implemented by the massive MIMO antenna array, and it would obviously improve the quality of the test network.