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Pattern reconfigurable antenna array for 5.8 GHz WBAN applications

Key words: Wireless body area network (WBAN); Pattern reconfigurable; PIN diodes; Controller network; Specific absorption rate (SAR)

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Motivation

1. Wireless body area network (WBAN) has drawn growing attention from a wide variety of applications, such as wireless communications, medical care, health monitoring, physical training, and military applications.
2. As the most critical component of WBAN devices, the antenna should be compact, easy to fabricate, robust to the influence of the human body, have a minimal specific absorption rate (SAR), and be low in cost.
3. Scholars worldwide have conducted extensive research around WBAN antennas with radiation pattern diversity.

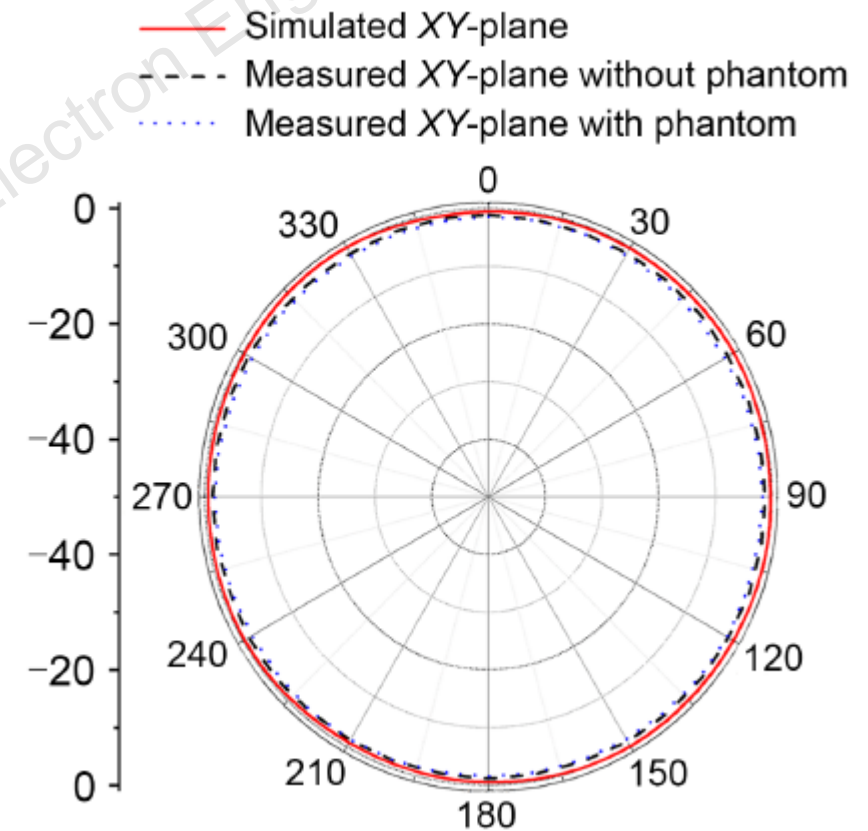
Method

1. The antenna array consists of a radiation component and a controller component. By controlling the PIN diode integrated in this controllable network, the omnidirectional radiation pattern tangent to the human body surface and the directional radiation pattern perpendicular to the human body surface can be obtained.
2. By using maximum power transmission optimization method, we can simply decide the amplitude and phase information for each port of the antenna array to fulfill different radiation need.
3. When the array is installed on the human body or forearm model, the impedance bandwidth, radiation pattern, and gain are measured, and the results are compared with the simulation.
4. SAR and beam switch ability of two radiation modes are simulated.

Major results

The radiation pattern is measured when the antenna array is mounted on a forearm phantom.

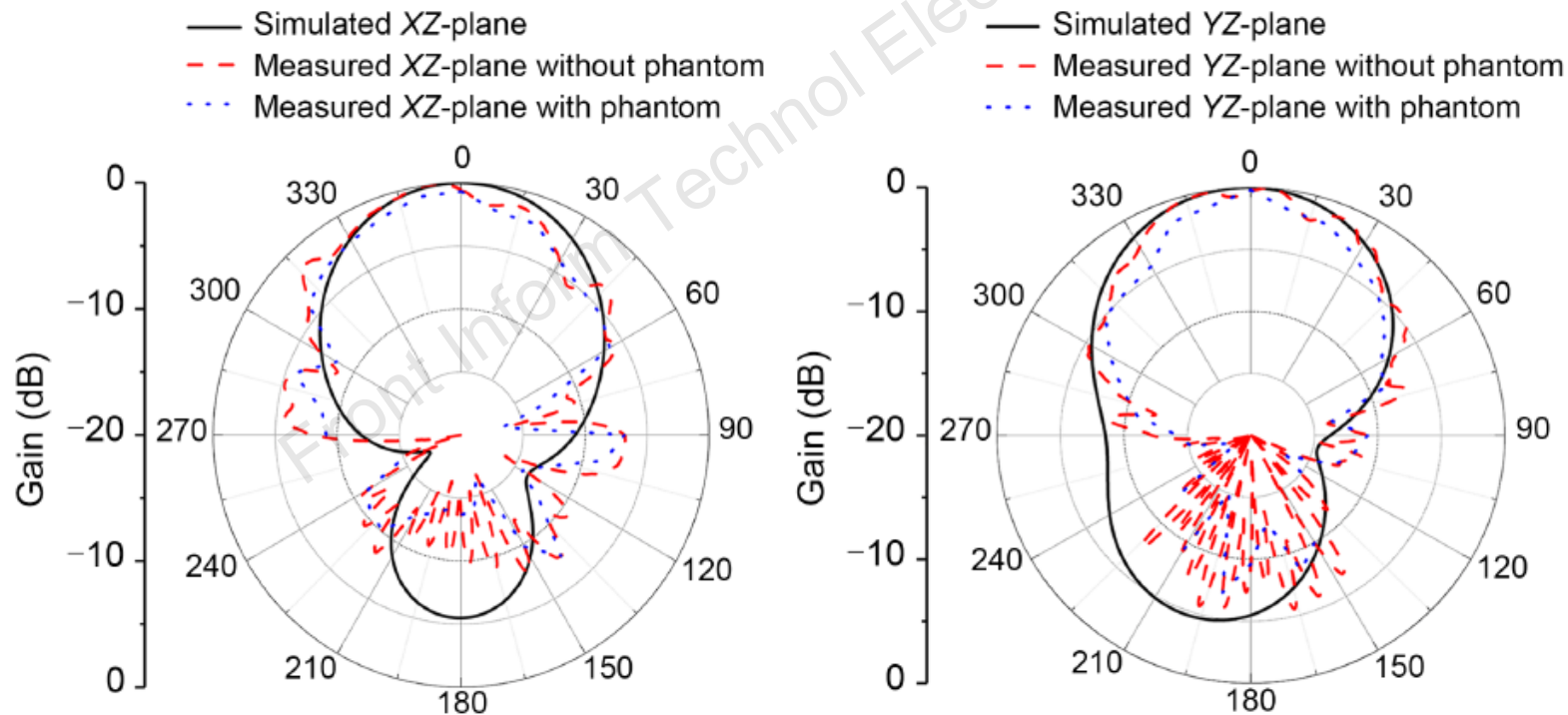
1. For omnidirectional mode, the simulation and measurement results agree well, and omnidirectional radiation characteristics can be observed in the XY -plane.



XY -plane for omnidirectional mode

Major results

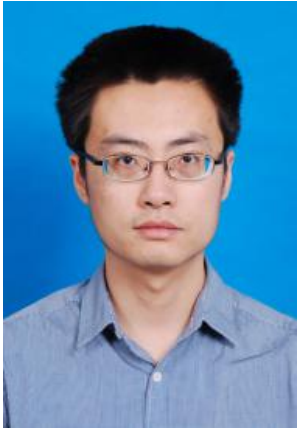
2. For the directional mode, the radiation patterns in XZ - and YZ -plane are drawn. It can be seen that the array radiates mainly in the $+Z$ axis direction, which is perpendicular to the human body surface.



XZ - and YZ -plane for directional mode

Conclusions

1. A four-element antenna array with pattern diversity for 5.8 GHz wearable applications is proposed in this paper.
2. By changing the working states of the PIN diodes, the array can switch between two radiation patterns: the omnidirectional radiation pattern and the directional radiation pattern.
3. When the array is attached to the human body or arm model, the measurement results of impedance bandwidth and radiation pattern are agree with the simulation results, and the methods used to design the directional mode can be simply extended to realize beam switchable functionality.



Lingsheng YANG received his BS degree in the Department of Communication Engineering, Nanjing University of Science & Technology, China, in 2001, and the MS and PhD degrees in the Faculty of Information Science and Electrical Engineering, Kyushu University, Japan, in 2009 and 2012, respectively. Since 2012, he has been an assistant professor in the School of Electronics & Information Engineering, Nanjing University of Information Science and Technology. He is the author of more than 40 articles, and more than 30 inventions. His research interests include antenna theory and design, MIMO, EMC, bioelectromagnetics, and lightning detection.



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