*** 北米連携センター定期報告***

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●テキサス大学、安価で小型な無線サーキュレーターを開発

【University of Texas at Austin, 2014/11/10】

テキサス大学オースティン校工学部の研究チームは、携帯電話をはじめとする無線通信端末で利用可能な極めて小型で効率性の高い無線サーキュレーターを開発した。

磁気に依存しないというこのサーキュレーターは、全二重通信を可能にし、無線通信の帯域利用効率を 2 倍にする可能性を持っているという。

磁気ベースのサーキュレーターは、過去 60 年にわたって同一周波数チャンネル上の双方向通信を可能にしてきたが、磁石・磁気素材を用いるためサイズや重量が大きくなり、コストもかかるのが欠点。

磁気への依存をなくした新しいサーキュレーターは、このような欠点を解消し、一般的な素材を用いることも可能になり、コストやサイズの効率化でサーキュレータを携帯電話などの端末に統合し、より高速で安定した通信が実現できる。

今回試作されたサーキュレータは 2cm で、研究チームによると、今後は数ミクロンにまで縮小できる可能性があるとのこと。また、素材には金、銀、シリコンなどが用いられている。

このサーキュレーターは、磁気サーキュレーターが選択的に無線を伝送していく機能を磁気を使わず再現しており、広範な周波数にリアルタイムに調整できるという特性も持っている。

（参考）本件報道記事

Lighter, Cheaper Radio Wave Device Could Transform Telecommunications

Nov. 10, 2014

Radio wave circulator developed by researchers at the Cockrell School of Engineering.

AUSTIN, Texas — Researchers at the Cockrell School of Engineering at The University of Texas at Austin have achieved a milestone in modern wireless and cellular telecommunications, creating a radically smaller, more efficient radio wave circulator that could be used in cellphones and other wireless devices, as reported in the latest issue of Nature Physics.

The new circulator has the potential to double the useful bandwidth in wireless communications by enabling full-duplex functionality, meaning devices can transmit and receive signals on the same frequency band at the same time.

The key innovation is the creation of a magnetic-free radio wave circulator.

Since the advent of wireless technology 60 years ago, magnetic-based circulators have been in principle able to provide two-way communications on the same frequency channel, but they are not widely adopted because of the large size, weight and cost associated with using magnets and magnetic materials.

Freed from a reliance on magnetic effects, the new circulator has a much smaller footprint while also using less expensive and more common materials. These cost and size efficiencies could lead to the integration of circulators within cellphones and other microelectronic systems, resulting in substantially faster downloads, fewer dropped calls and significantly clearer communications.

The team of researchers, led by Associate Professor Andrea Alu, has developed a prototype circulator that is 2 centimeters in size — more than 75 times smaller than the wavelength of operation. The circulator may be further scaled down to as small as a few microns, according to the researchers. The design is based on materials widely used in integrated circuits such as gold, copper and silicon, making it easier to integrate in the circuit boards of modern communication devices.

Associate Professor Andrea Alu of the Cockrell School of Engineering.

"We are changing the paradigm with which isolation and two-way transmission on the same frequency channel can be achieved. We have built a circulator that does not need magnets or magnetic materials," Alu said.

The researchers' device works by mimicking the way magnetic materials break the symmetry in wave transmission between two points in space, a critical function that allows magnetic circulators to selectively route radio waves. With the new circulator, the researchers accomplish the same effect, but they replaced the magnetic bias with a traveling wave spinning around the device.

Another unique feature is that the new circulator can be tuned in real time over a broad range of frequencies, a major advantage over conventional circulators.

"With this technology, we can incorporate tunable nonreciprocal components in mobile platforms," said Nicholas Estep, lead researcher and a doctoral student in the Department of Electrical and Computer Engineering. "In doing so, we may pave the way to simultaneous two-way communication in the same frequency band, which can free up chunks of bandwidth for more effective use."

For telecommunications companies, which pay for licenses to use frequencies allotted by the U.S. Federal Communications Commission, a more efficient use of the limited available bandwidth means significant cost advantages.

Additionally, because the design of the circulator is scalable and capable of circuit integration, it can potentially be placed in wireless devices.

"We envision micron-sized circulators embedded in cellphone technology. When you consider cellphone traffic during high demand events such as a football game or a concert, there are enormous implications opened by our technology, including fewer dropped calls and clearer communications," Estep said.

The circulator also could benefit other industries that currently use magnetic-based circulators. For instance, circulators used in phased arrays and radar systems for aircraft, ships and satellites can be extremely heavy and large, so minimizing the size of these systems could provide significant savings.

"We are also bringing this paradigm to other areas of science and technology," Alu said. "Our research team is working on using this concept to protect lasers and to create integrated nano-photonic circuits that route light signals instead of radio waves in preferred directions."

This research was supported by the Defense Threat Reduction Agency and the Air Force Office of Scientific Research.

The University of Texas at Austin is committed to transparency and disclosure of all potential conflicts of interest. All UT investigators involved with this research have filed their required financial disclosure forms with the university. None of the researchers have reported receiving any research funding that would create a conflict of interest or the appearance of such a conflict.

Source: http://www.utexas.edu/news/2014/11/10/radio-wave-device-alu/

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