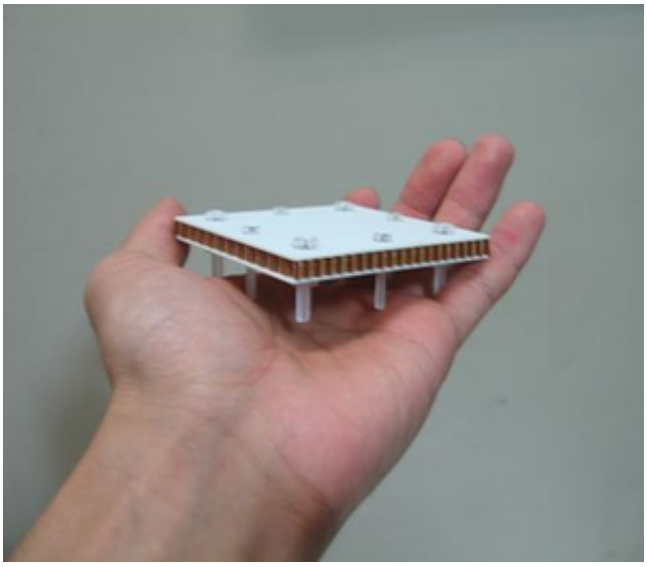
Goodbye, Bunny Ears: Future Antennas May be Flat

April 24 2008, By Lisa Zyga



The smart-skin antenna could replace protruding antennas on airplanes to prevent weakening of the plane's mechanical strength. The new antenna might also be used in consumer electronics devices. Credit: Seong Ho Son, et al.

The long, wiry antennas that protrude from airplanes, cars, cell phones – and even the bunny ears on some TVs – may one day become novelty items. Researchers are developing a smart-skin antenna that is simply a thin patch of electrical elements, which could contain a variety of antennas for different purposes within its palm-sized surface.

A team of researchers – Seong Ho Son and Soon Young Eom from the

Electronics and Telecommunications Research Institute in the Republic of Korea, and Woonbong Hwang of the Pohang University of Science and Technology in the Republic of Korea – has recently developed a smart-skin material that contains embedded microstrip antennas. The smart-skin could, for example, become an integral part of a plane or other vehicle, where it could be used for radar, communications, broadcasting reception, GPS, and other applications.

"The smart-skin antenna provides a new paradigm where the structural surface becomes an antenna," Hwang told *PhysOrg.com*. "Because the new kind of antenna is integrated into the structural surface, the antenna can be aerodynamically designed; the appearance is very nice and no outer space is required for the antenna installation. [In airplanes,] the installation of protruding antennas weakens the mechanical strength of its structure. So the smart-skin antenna can also improve the structural performance."

As the researchers explain in a study published in Smart Materials and Structures, the smart-skin is made of an organic honeycomb structure sandwiched between two dielectric layers. Several microstrip antennas – basically, metal patches – are embedded within the honeycomb structure in layers. The flat antennas can then radiate radio-frequency signals, and have a scanning range of 90 degrees.

Stacking microstrip antennas of slightly different sizes slightly offsets their frequencies, which in turn increases the bandwidth of the frequencies and enables faster functioning. The current system, which operates at 7.5 GHz frequency, has a bandwidth that exceeds 500 MHz.

The honeycomb structure can also accommodate antenna arrays to produce a directional radiation pattern. By precisely spacing the antennas and changing the phase, the array can also perform electronic beam scanning.

The researchers suggest that the new multi-functional smart-skin might replace the many antennas that typically protrude from vehicles. The flat antenna design could also lead to innovative radio-frequency communication in vehicles.

“The smart-skin antenna, with a lightweight, durable, and load-bearing structure, could replace the body and roof panels of vehicles,” Hwang said. “Then, the structural surface itself makes it possible to get services including AM/FM, TV, GPS, DAB (Digital Audio Broadcasting), and DMB (Digital Multimedia Broadcasting).”

Hwang added that consumer electronics devices, which often rely on wireless communication, could also use the smart-skin antenna concept.

“Traditionally, the necessary antennas are separately installed into the case of the device and/or are protruded from the case,” he said. “However, the smart-skin antenna technology is helpful to design the new case with structurally-integrated antennas in electronics devices such as cellular phones, laptop computers, etc.”

More information: Son, Seong Ho; Eom, Soon Young; and Hwang, Woonbong. “Development of a smart-skin phased array system with a honeycomb sandwich microstrip antenna.” *Smart Mater. Struct.* 17 (2008) 035012 (9pp).