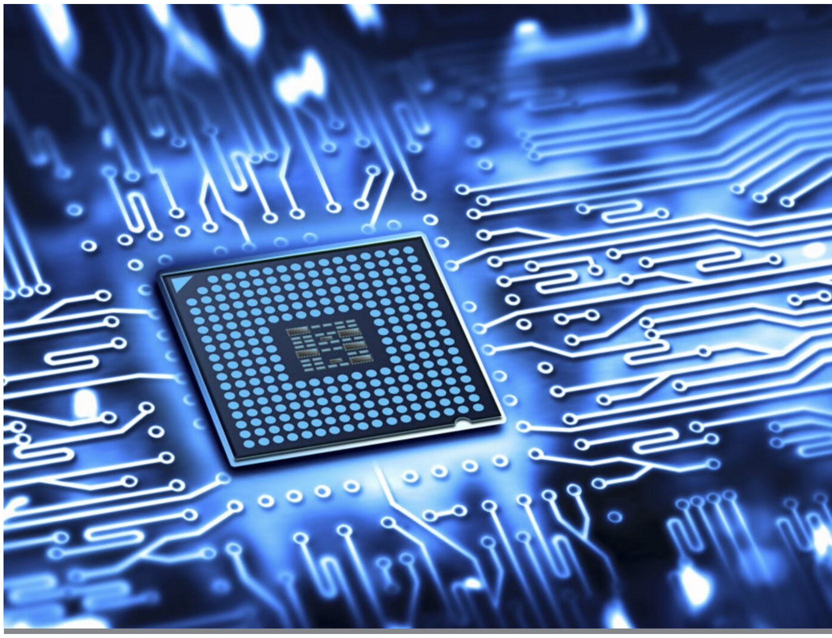


National Aeronautics and
Space Administration

TECHNOLOGY SOLUTION

Electrical and Electronics

Automated Fabric Circuit and Antenna Fabrication

Improves performance of e-textiles through automation

Innovators at NASA Johnson Space Center have developed a cost-effective method to create fabric-based circuits and antennas by combining conventional embroidery with automated milling. The technology allows for higher surface conductivity, improved impedance control, expanded design and application potential, and greater choice of materials for optimized performance. Previous efforts to automate fabric circuit and antenna fabrication have faltered on either the complexity of the manufacturing hardware and associated costs, or design and application limitations of the resulting e-textiles. This fabrication method offers benefits in cost and labor savings and provides opportunities for the development of design patterns with higher geometric complexity and performance improvements.

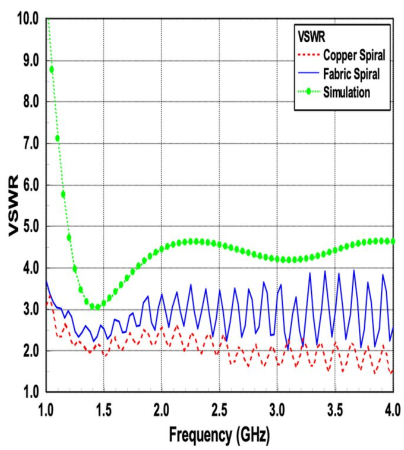
BENEFITS

- Mirrors methods used for fabrication of conventional rigid PCBs and printed antennas
- Permits use of materials that enable traces characterized by high surface conductivity
- Allows control of line characteristic impedance for applications over a wide range of the electromagnetic spectrum
- Actualizes complex single and multi-layered circuits with high degrees of geometric complexity
- Setup costs comparable to wet-etch process commonly used for flexible and conventional rigid PCBs

THE TECHNOLOGY

Modern production of e-textiles utilizes an embroidery technique called “e-broidery” that directly stitches circuit patterns with conductive thread onto textiles. This automated manufacturing process combines steps of e-broidery and milling to expand the application of e-textiles to high-current and high-speed uses. Manufacturing begins with two layouts of the desired conductive pattern. After assembling the layers of conductive and nonconductive materials, e-broidery is performed with the second layout and nonconductive thread to secure the layers together and designate the pattern for the conductive material. The secured assembly is transferred to an automated milling or laser cutting machine, which cuts the desired conductive pattern and releases the unneeded portions of the conductive material. The resulting e-textiles are tightly woven together, providing higher surface conductivity and impedance control. Initial comparison tests assessing the performance of fabric-based spiral antennas developed with this method, compared to conventional antennas, indicated no loss in performance across multiple metrics, including voltage standing wave ratio (VSWR), radiation pattern, and axial ratio performance.

The Method and Apparatus for Fabric Circuits and Antennas is a technology readiness level (TRL) 6 (system/subsystem prototype demonstration in a relevant environment). The innovation is now available for your company to license. Please note that NASA does not manufacture products itself for commercial sale.



Fabric spiral antennas using this method performed similarly to conventional copper antennas across multiple metrics, including VSWR.

Shown is a fabric-based spiral antenna prototype comprised of Nora Dell conductive fabric, a polyester fabric substrate, and RG178 coaxial cable.

APPLICATIONS

The technology has several potential applications:

- Aerospace: lightweight fabric antennas for fabric skin aircraft and unmanned autonomous vehicles (UAVs); advanced sensors/antennas for spacesuits
- Military: digital battlefield apparel can be embedded with stealth and flexible electronics and antennas
- Textiles/wearables: wireless or cellular networking, RFID, sensors, GPS

PUBLICATIONS

Patent No: 8022307

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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