Textile EBG Space Suit Antennas (TESSA)

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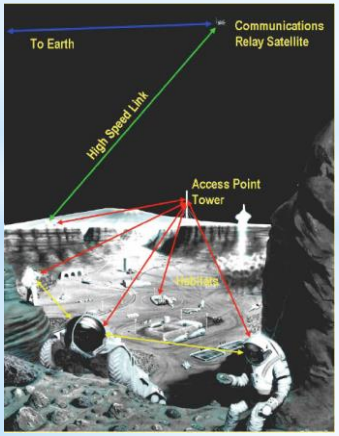
Introduction

* Currently the second generation of North Dakota Space Suit (NDX-2).
* While image transmission was a part of wireless communication system in the first generation (NDX-1), it was very limited to analog low resolution images.
* The plan is in addition to voice, image and video streaming, develop a biomedical monitoring system.
* To enhance the communication bandwidth better antennas with higher gain and small size are required.

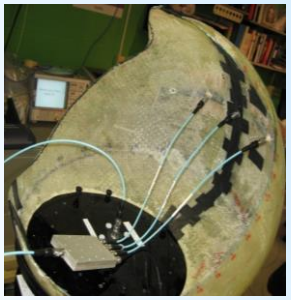
*Relevance to NASA

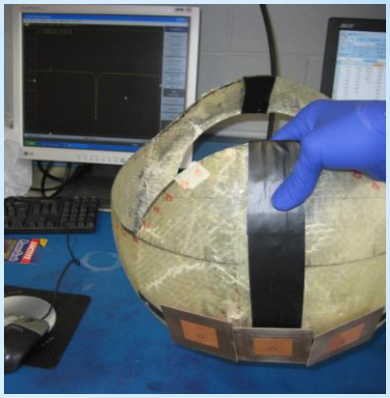
* One of the areas of interest to NASA is the improvement of space suit systems to perform extended Extra Vehicular Activities (EVA's) space suit.
* The future constellation space missions and the return to the Moon by 2020, requires astronauts to spend more time performing EVA's than ever before.
* Hence, maintaining communication for transferring data and monitoring astronaut's health become a vital part of missions.



Pervious Design

* In pervious design we used microstrip patch antennas on solid substrate.
* Two problems with the previous design:
  * No flexibility
  * Size
* Two overcome these problems:
  * Textile antennas
  * Electronic Band Gap (EBG) antennas





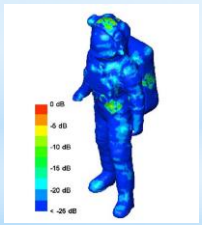
*Prior Work

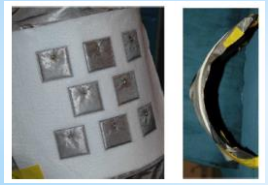
* Design and Characterization of Purely Textile Patch Antennas. Ivo Locher, Maciej Klemm, Tunde Kirstein, and Gerhard Troster. IEEE Transactions on Advanced Packaging, Vol. 29, No. 4, November 2006.

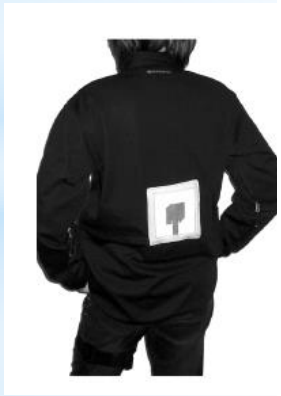
* Study on the Performance Deterioration of Flexible UWB Antennas. T. Peter and R. Nilavalan. 2009 Loughborough Antennas & Propagation Conference.

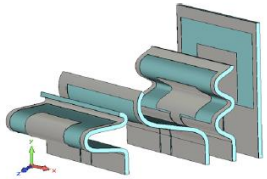
* Bent and Crumpled Textile Antenna. Qiang Bai and Richard Langley. Proceedings of 33rd ESA Antenna Workshop on Antennas for Space Applications, 5-8 Oct. 2010.

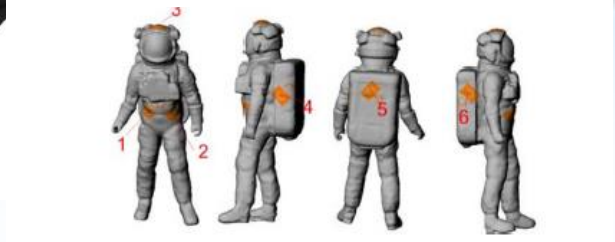
* Body-Worn E-Textile Antennas: The Good, the Low-Mass, and the Conformal. Timothy F. Kennedy, Patrick W. Fink, Andrew W. Chu, Nathan J. Champagne, II, Gregory Y. Lin, and Michael A. Khayat. IEEE Transactions on Antennas and Propagation, Vol. 57, No. 4, April 2009.

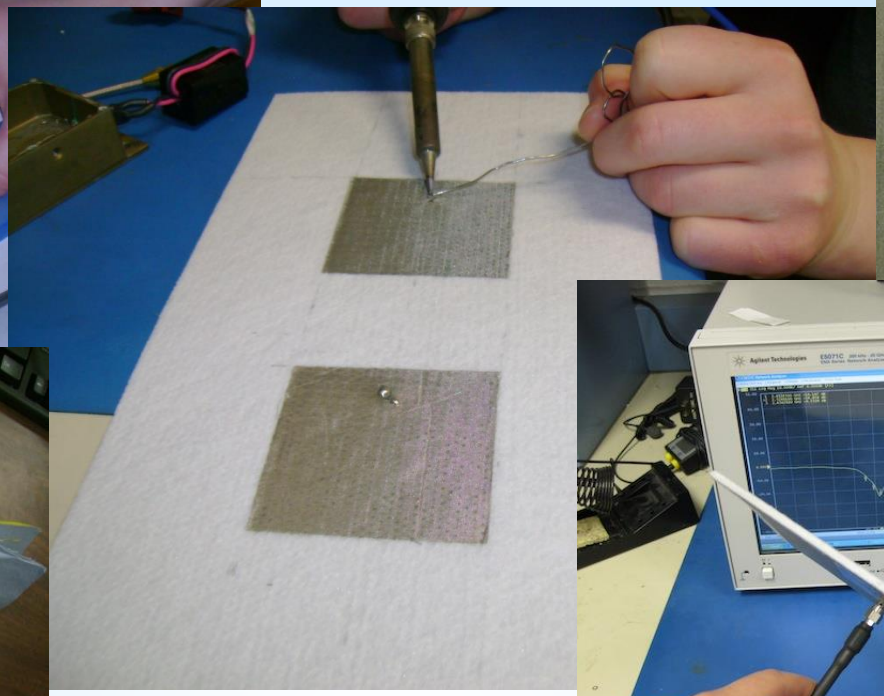


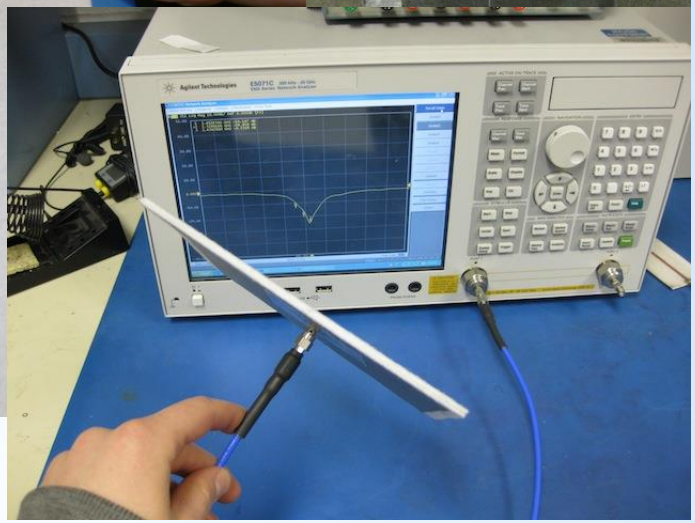


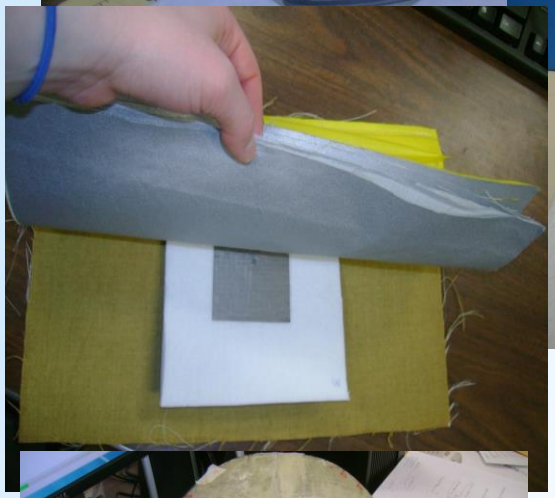


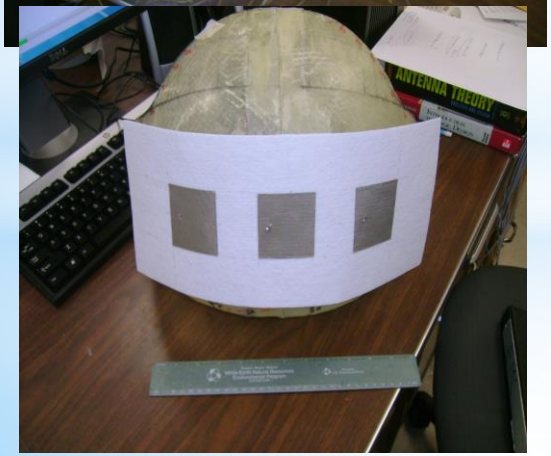






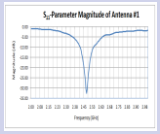
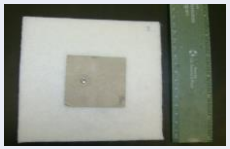
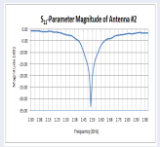
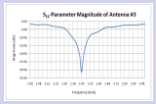
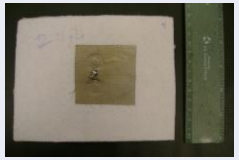
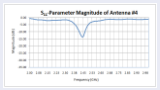
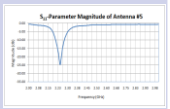






*Current Activities

*Results

Antenna #	Substrate	Patch/Ground	S11	Patch Length	Patch Width	freq. (GHz)
 1	Peltex 70	Nickel/Copper Polyester Ripstop		50.5	54	2.52
 2	Felt	Nickel/Copper Polyester Ripstop		51.5	54	2.47
 3	Peltex 70	Nora Dell		51.5	58.5	2.45
 4	Peltex 72	Nickel/Copper Polyester Ripstop		51.5	57	2.44
 5	Stiffened Felt	Armor RTF		57.5	55	2.24

Collaborations

- Established collaboration with Pablo De Leon and UND Spacesuit Laboratory.
- Current collaboration with Dr. Reza Fazel-Rezai and possible proposal for health monitoring systems for spacesuit.
- Have discussed possible collaboration with Dr. Vahraz Jamnejad from Jet Propulsion Laboratory (JPL).
- Possible collaboration with Dr. Lu (University of Texas Arlington) on self-powered antenna arrays.

Future Plans

- Prepare proposal on Textile Antennas for Space Suit
- Continue working on Metamaterial Antennas (EBG) for Space Suit
- Plan to prepare a proposal for NASA (ROSES 2011, possibly C16 or A41)

TESSA Team

- Tessa Haagenson(B.Sc. Student)
- Corey Bergsrud (M.Sc. Student)
- Rakesh Nath (M.Sc. Student)