

## The Telecommunication Research Group

On April 2004 PRIDCO funded the **Smart Antenna Laboratory** in order to develop infrastructure and research in the areas of Wireless Communication and Array Processing at Polytechnic University of Puerto Rico. Since then, the Smart Antenna team has mentored the creation of new research laboratories, sponsored countless technical conferences and spearheaded the formation of a unified research group in the area of Telecommunications.

### Mission

Research and development of Digital Signal Processing (DSP) based, telecommunication algorithms with high commercialization or licensing potential. Our research group also does antenna and electromagnetics modeling and simulation.

We welcome industry and academic partners interested in pursuing any of the mentioned areas of research.

### Smart Antenna Laboratory

The research carried out at this laboratory is directed to the development of sophisticated smart antenna algorithms & processors. The Smart Antenna Team is also developing infrastructure in the Telecommunication field at PUPR. We have created new courses, sponsored new laboratories and published. We are also directing several graduate students who are doing their Master Thesis in Wireless Communications and related fields.

### Computational Electromagnetics Laboratory

This laboratory specializes in running complex models and simulations of antennas and antenna arrays. It is currently heavily involved with the High Performance Computing laboratory. This is in order to do parallel processing and therefore dramatically reduce (in

hours) the simulation time required to run some of these models.

### Signal Processing Laboratory

The research is mainly focused on the development of DSP-based Telecommunication algorithms.

### Reconfigurable Hardware Laboratory

Using FPGA technology, this laboratory is intended as a support facility for the areas of Logic Circuits, Computer Architecture, Digital Signal Processing, and Telecommunication among others.

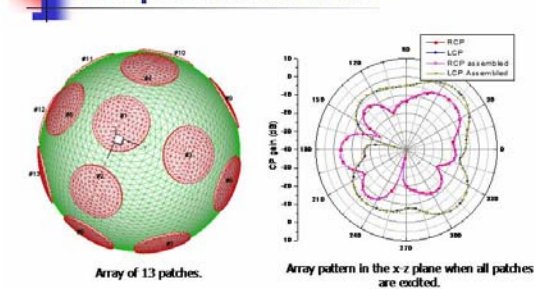
### Computational Resources

Our research group has access to state of the art PC workstations, SGI workstations and to a 64-Node Dell Cluster that operates as part of the PUPR High Performance Computer Center.

### Areas of Research (Partial List)

Array Processing, Direction of Arrival Algorithms, Parallel Processing, Fast Fourier Transform Algorithms, Parallel DSP Algorithms, Antenna Simulation using the Finite Difference Time Domain Method, Smart Antenna Technology, High Performance Embedded Computing, FPGA.

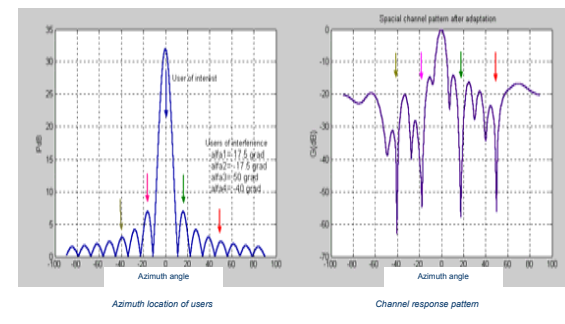
### Conformal Array of Patches on Spherical Surface



## People

**Faculty Associates:** Dr. Viktor Zaharov, Dr. Marvi Teixeira, Dr. Nader Farahat, Dr. Angel González.

**Current Graduate Students:** Jesús Sanchez, José Carrión, Jorge Agosto, Miguel De Jesús, Yamil Rodríguez, Leandro Morales, James Acosta, Angel Sepulveda.



### TRG Publications: 2004-2005

**Nader Farahat** and Raj Mittra, "Multiscale Analysis of Panel Gaps in the Haystack Parabolic Reflector," Proceedings of ACES05, Honolulu, Hawaii, April 3-7, 2005.

**Nader Farahat, Jose Carrion** and **Leandro Morales**, "PML Termination of Conducting Media in the FDTD Method for Bodies of Revolution (BORs)", 2005 Workshop on Computational Electromagnetics in Time-Domain (CEM-TD), **September 12 - 14, 2005, Atlanta, Georgia, MTTs, IEEE**. Accepted for Publication.

**V. Zaharov** and **M. Teixeira**, "Modified Implementations of RLS Digital Beamforming" 2005 IEEE AP-S International Symposium on Antennas and Propagation and USNC/URSI National Radio Science Meeting, Washington, DC, USA on July 3-8, 2005. (accepted for publication).

**Jorge Agosto, Nader Farahat** and Raj Mitra, “Analysis of Inter-element Mutual Coupling in Wireless Antenna Array Using Finite Difference Time Domain Method,” IEEE, AP-S05, Washington DC, July 3-8, 2005. Accepted for publication.

**José Carrión** and **Nader Farahat**, “Analysis of Discontinuities in Circular Waveguides using Finite Difference Time Domain Method,” IEEE, AP-S05, Washington DC, July 3-8, 2005. Accepted for publication.

**Nader Farahat**, Raj Mitra and **Jesus Sanchez**, “Analysis of the Surface-Deflection Effect on the Performance of the Haystack Reflector Antenna,” IEEE, AP-S05, Washington DC, July 3-8, 2005. Accepted for publication.

**Nader Farahat**, Raj Mitra and **Jorge Agosto**, “Mutual Coupling in Interconnect Lines; Analysis Using Finite Difference Time Domain Method,” Proceedings of SPI05, Garmisch-Partenkirchen, Germany, May 10-13, 2005.

**Nader Farahat**, Raj Mitra and **José Carrión**, “Finite Difference Time Domain Modeling of a Corrugated Horn Antenna as a Radar System Feed,” Journal Paper, Under Review .

**Leandro Morales**, graduate student, Advisor: **Dr. Viktor V. Zaharov**. “Smart, Antenna Beamformer” Implementation. 25th PR Interdisciplinary Scientific Meeting March 12, 2005, Mayaguez, Puerto Rico

**James Acosta**, graduate student, Advisor: **Dr. Viktor V. Zaharov**. “Switched Beam Smart Antenna with Beam - Space Processing”. 25th PR Interdisciplinary Scientific Meeting March 12, 2005, Mayaguez, Puerto Rico

**Miguel De Jesús**, graduate student. Advisor: **Dr. Marvi Teixeira**, “Antenna Array Pattern Synthesis with Prescribed Nulls: a Non-Uniform DFT Approach”. 25th PR Interdisciplinary Scientific Meeting March 12, 2005, Mayaguez, Puerto Rico

**Jesús Sánchez, Miguel De Jesús**, graduate students. Advisor: **Dr. Nader Farahat & Dr. Marvi Teixeira**. “Radiation Pattern from Microwave Reflectors with Random Surface Errors.” 25th PR Interdisciplinary Scientific Meeting March 12, 2005, Mayaguez, Puerto Rico

**Miguel De Jesús, Yamil Rodríguez, Iliamelis Soto**, graduate students. Advisor: **Dr. Marvi Teixeira**. “Algorithms for Parallel Cyclic Convolution”. 25th PR Interdisciplinary Scientific Meeting March 12, 2005, Mayaguez, Puerto Rico

**Morales L.** and **V. Zaharov**, “Smart Antenna Adaptive Algorithms Development for 3G Cellular Communication with Training Signal” , CRC 2004, Mayaguez, Puerto Rico.

**Cabrera D., J. Rodríguez and V. Zaharov.**, “Switched Beam Smart Antenna BER Performance Analysis for 3G CDMA Cellular Communication” , CRC 2004, Mayaguez, Puerto Rico.

**De Jesús M, Y. Rodríguez, L. Vicente, and M. Teixeira**, “Non-Uniform Discrete Short-Time Fourier Transform A Goertzel Filter Bank Approach “ , CRC 2004, Mayaguez, Puerto Rico.

### Contact Information

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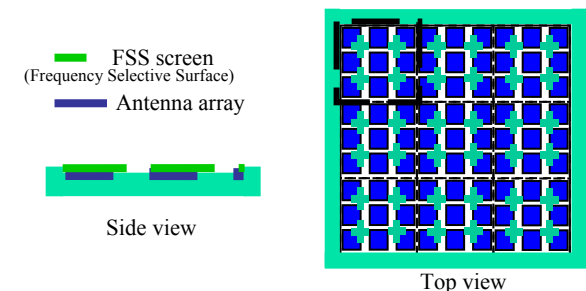
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## Electrical and Computer Engineering and Computer Science Department



## Telecommunication Research Group



### Research Laboratories:

- Smart Antenna Laboratory (PRIDCO Support)
- Computational Electromagnetics Laboratory
- Signal Processing Laboratory
- Reconfigurable Hardware Laboratory

 **PRIDCO** Puerto Rico Industrial Development Company of the Commonwealth of Puerto Rico

