CASE STUDY

The Transforming Antenna Center Boosts Research, Resources, and Recruitment for FIU

LEARN HOW…

Florida International University uses MVG antenna measurement systems and advanced post-processing tools to broaden research lab reach and give engineering students edge in careers.

Professor Stavros Georgakopoulos
Director of the Transforming Antenna Center, Florida International University

“To remain competitive, secure funds for our research, and continue to advance innovation in promising areas such as space, we need a lab that is not only operational and cost-effective, but efficient. With fast and accurate MVG antenna test systems, we have been able to prosper and expand into new, aspiring technological areas and increasingly diverse antenna design projects.”

FIU | Engineering & Computing

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StarLab 18 GHz in TAC antenna research lab of FIU

CHALLENGE

Florida International University (FIU) is home to the Transforming Antenna Center (TAC), a focused research lab originating in the development of deployable (transforming) origami antennas for military and space applications. The patented origami antenna is an invention of the center's director, Professor Stavros Georgakopoulos who has been the driving force behind the development of this technology as well as the successful establishment and expansion of this prominent antenna design center in the heart of Miami.

Initial challenges that Professor Georgakopoulos and his team faced included not only funding his ambitious and promising origami antenna project, but also creating and expanding the lab to gain the capacity to measure and develop a wide variety of antenna projects.

Secondly, the professor could see how engineering programs were key for universities in gaining recognition and attracting promising students eager to discover the next big technological breakthrough. He believed developing a dedicated research lab would support the growth of FIU, appealing specifically to engineering students aiming to take part in developing tomorrow's technologies through RF and antenna engineering.

And finally, from the professor's own experience from Industry, he realized that engineering students needed hands-on experience in equipment use if they were to attract future employers of their choice.

Turning these challenges into objectives, the Transforming Antenna Center at FIU soon took shape.

SOLUTIONS

Professor Georgakopoulos, seeing huge opportunities for his deployable origami antennas in space applications, moved to pursue funding opportunities. In 2013, the professor received initial funding by the National Science Foundation (NSF) and the Air Force Office of Scientific Research (AFOSR) to pioneer the research and development of origami antenna technology. Then, he received follow-up funding by AFOSR in 2018 and 2019 to establish the TAC. From basic evaluations in its first simulation tools to the capacity to build full-scale operational prototypes, the lab has gradually reached full antenna design capacity. And the capacity to conduct accurate measurements to validate all design iterations in-house has been essential in several ways.

The StarLab 18 GHz by MVG was the first antenna measurement system acquired for the lab in 2014. This compact and portable multi-probe antenna measurement system can characterize an antenna in minutes in frequency bands from 650 MHz to 18 GHz. A first noticeable return on investment in the StarLab was that researchers were able to have direct test results of their antenna design progress for their publications; Publications that showed proof of the value of their work and could give support for more funding. Secondly, with the StarLab, they were able to

"The process of analysis and design immediately became much faster! We were able to test and have complete data in a matter of hours as opposed to days when working with a test house. We were also able to own the process. This was very important for us! We avoided loss of information and time in hand-over instructions and maintained full control of the process."

perform tests and measurements in house, thereby gaining considerable time in the research process. The testing of each iteration of an antenna in development could at last be done quickly onsite and in a controlled environment.

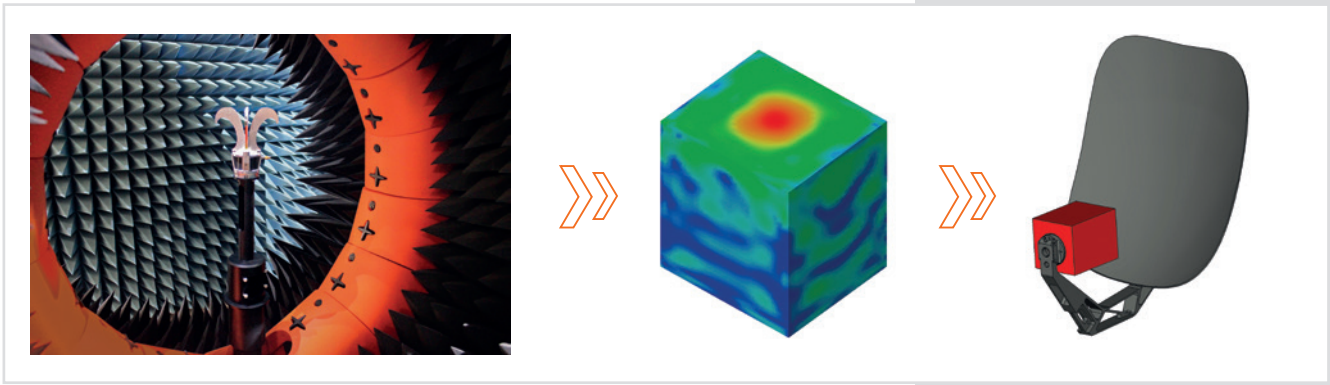
Having a fully functional research lab has brought many other advantages to TAC. With the StarLab 18 GHz, they have been able to expand the lab's research program capacity to include a wide variety of antenna design projects working in frequencies from 650 MHz to 18 GHz. They have advanced research on space applications for the origami antennas and have also moved forward on designs for a multitude of other antenna applications such as wearables, MIMO, or wireless biomedical devices.

One surprising discovery Professor Georgakopoulos made was in the use of Insight, advanced post-processing software by MVG that they had purchased with the StarLab 18 GHz. Initially they used it moderately, but eventually found its full potential in combining simulation and antenna measurements.

More than simply speeding up tests using simulation, Insight has given them the means to have a true representation of a source antenna (through equivalent source modelling) for their simulations. It has also allowed them to rapidly diagnose problems that measurement data may reveal, so they can use it to go back and identify the precise problem.

"Insight is incredibly powerful, and we now use it all the time for our research. It is very valuable to be able to have the actual source antenna rather than an unknown model in our simulations".

Professor Stavros Georgakopoulos



Finally, having instrumentation in the TAC lab has strengthened the appeal of the university to future engineering students as well as to industry. Future students see that they can gain valuable practical experience as they work on their own projects from beginning to end. They understand that through such training, they will comprehend all technical aspects of the design process thanks to the full set of measurement systems in the lab and a "super-user" system that has been organized for the transfer of knowledge. They also realize how it could give them a competitive edge in the job market. On the opposite side of the scale, industry has not only become more interested in investing in research projects conducted at FIU, but increasingly appreciates how FIU engineering graduates have the practical experience right out of university that many others do not. Recruiters have been knocking at the door.

PROGRESSION TOWARD DESIGN OF HIGHER FREQUENCY ANTENNAS

As time progresses, high frequency antenna projects have been gaining interest, with 5G and 6G technologies underway, and research into higher wavebands ramping up. TAC began reaching its test capacity as its antenna measurement limits maxed out at 18 GHz in its MVG Starlab. A new measurement system was required that could not only test AUTs at far higher frequencies, but could do so in a way that was just as fast and accurate as the StarLab in meeting the needs of a rapid characterization and prototyping environment.

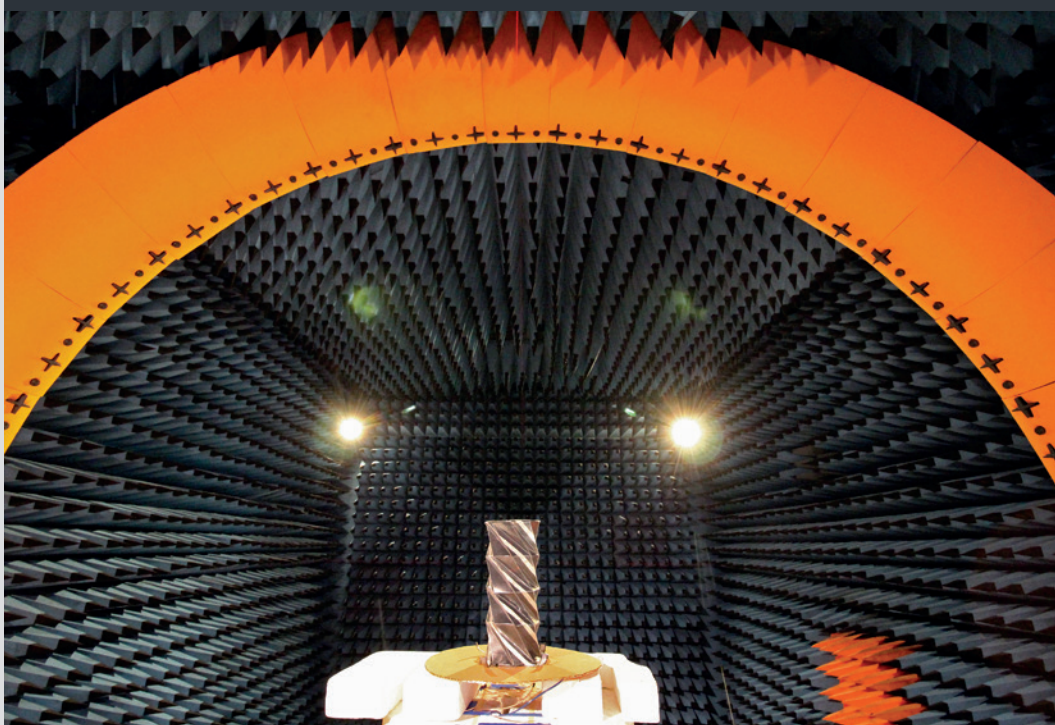
Then, FIU's RF faculty team (Professors Alwan, Bhardwaj, Georgakopoulos, Mohammed, and Volakis) received new NSF funding to acquire the MVG Microlab. The additional compact antenna measurement system would offer FIU the capacity to continue research and development of antennas in the millimeter wave frequency bands. It would complete the capabilities of TAC by enabling measurements of frequencies from 18 GHz up to 110 GHz, thereby taking over where their StarLab 18 GHz left off.

Since their acquisition of the MicroLab, they have already began making headway, testing at frequencies up to 60 GHz, following suit with antennas planned to function at even higher frequencies.

WHEN SIZE BECOMES AN ISSUE

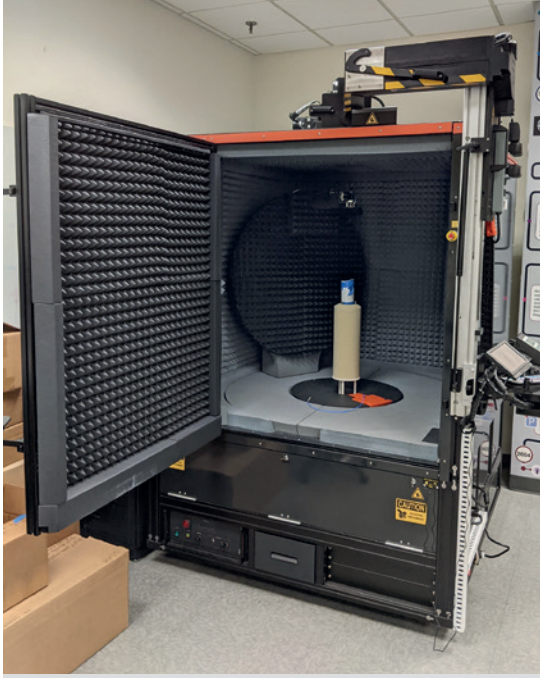
TAC has been organized to function in an efficient, designated lab space. As the lab has grown, antennas of all shapes and sizes have been developed. Some have sizes too big for any of the compact test systems in their local lab. The quick fix was found in the measurement services of MVG.

Origami antenna designed at TAC in SG 64 at MVG, Inc., Atlanta.



One such occasion occurred within the last year and knowing that a larger multi-probe system, the SG 64, was available for measurement services in Atlanta, the team at TAC contacted MVG to set up measurements for one of the biggest origami antennas they had designed to date. Though the process was expectedly longer than their familiar in-house procedure, they chose to entrust their measurements to the MVG team, confident they could get the exact services and technical data they would need to validate their antenna design and advance their research. With this solution, big antennas to be measured became a non-issue.

As design focuses on 5G and envisions 6G frequencies, antennas are becoming more complex, but luckily for TAC's current test capacity, most are also decreasing in size. Nevertheless, the lab is still ambitiously expanding, acquiring new equipment and capabilities. Bigger antennas will need bigger test systems and Professor Georgakopoulos is looking for ways to push the walls out and make room for a full-sized test chamber and system, such as the MVG SG 64, in house.



MVG MicroLab in TAC antenna research lab at FIU

BENEFITS:

1. **Compact, all-in-one systems** – both StarLab and Microlab are compact and portable – they can be used whenever, wherever they are needed.
2. **Powerful software tools** – measurement software that is intuitive, and post-processing software that adds flexibility in the design & measurement process through precision diagnostics.
3. **Speed** – fast measurements, fast turn-arounds, fast test and measurement process all together.
4. **Accurate testing** – precise results not only assure reliability of end-products, they add to the increased speed of the design process.
5. **In house capabilities** – Saves time, gives complete control over owned projects (hands-on student use), encourages practical experience.
6. **Flexibility and confidence in services** – when space and size become an issue, test and measurements can be provided by MVG labs in Atlanta.
7. **Recruitment tool** - stimulates innovation and diversity of design projects and as a result garners promising students, projects, and investments.

Our StarLab has been the centerpiece of antenna design and fast testing at TAC. Now with the MicroLab, we are set to reach higher and wider frequency measurements. With bigger systems, higher frequencies, faster throughputs, MVG supports our needs and we look forward to continued compatibility and collaboration.

Professor Stavros Georgakopoulos

THE FUTURE OF ANTENNA DESIGN

The Transforming Antenna Center at Florida International University works at the forefront of antenna technology – a sector that is evolving at a fast pace. The team's future plans include designing and testing antenna technologies that operate at up to 300 GHz and even into the terahertz bandwidths. Further investment into state-of-the-art testing technology will be required.

Professor Georgakopoulos sees space as the "next frontier", with incredible opportunities for antenna technologies, like origami antennas. These antennas, compact for launch and travel and deployable once in space to reach the maximum aperture possible, will be useful as the limited real-estate available on satellites continues to shrink.

As antenna designs evolve, measurement systems to characterize and verify antenna performance must anticipate advancing needs. Currently, MVG measurement systems support TAC's research to develop cutting-edge technologies for future applications. They deliver accurate and repeatable results via a straight-forward and fast testing process. These systems must continue to be in advance of TAC's future test and measurement needs.

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Professor Stavros Georgakopoulos presenting an origami antenna about to be tested in the StarLab

Images courtesy of Florida International University

Maximum Testing, Minimal Footprint

STARLAB 18 GHZ

The StarLab is a compact multi-probe test system specially designed by MVG for antenna pattern measurements in laboratories and production environments where space is limited. It combines the flexibility of a portable system with the reliability of a laboratory tool able to precisely measure the performances of a product at each stage of its design. The 3 StarLab models proposed by MVG cover wideband frequencies: The StarLab 6 GHz - 650 MHz to 6 GHz, the StarLab18 GHz - 650 MHz to 18 GHz, and the StarLab 50 GHz- 650 MHz to 50 GHz, measure typical antenna parameters including gain, directivity, beamwidth, antenna efficiency, radiation patterns, as well as TRP, TIS, EIRP and EIS for OTA.

MICROLAB

The Microlab is a compact and portable measurement system designed to characterize microchips and miniature antenna assemblies operating in the millimeter wave frequencies between 18 GHz and 110 GHz.

It is designed to fit through standard double doors, with a compact anechoic chamber measuring approximately 152 cm^3.

Inside the chamber, there is an azimuth positioner and elevation gantry arm, allowing a spherical coverage of the AUT. The AUT is fixed and does not rotate. It is mounted on a center-mounted column for connectorized antennas and partially or fully packaged devices. For on-chip antennas, an offset mounted column is used to accommodate a microprobe assembly. A manual polarization rotation capability for the near-field probe is supplied. The system can either support spherical near-field measurements using the appropriate near-field to far-field transformations, or directly measure the far-field characteristics for appropriate conditions, for example, the testing of a 1 cm antenna at 110 GHz which requires a far field distance of only about 7 cm.

This test system provides a versatile, flexible solution to the testing of millimeter wave antennas destined for high frequency applications.

With full turn-key antenna test systems like the StarLab and Microlab, university research labs, like TAC at Florida International University, can manage their R&D efficiently and in a cost-effective manner.

Powerful Add-ons and Flexible Services

INSIGHT

Insight is an advanced post-processing software tool for antenna analysis and diagnostics. It allows for the reconstruction of equivalent electromagnetic current distributions and extreme near fields on antennas under test. The latest updates propose a link between measurements and simulations: Starting from an antenna measurement, an equivalent model in the form of a near-field Huygens' box is created. The equivalent model can then be applied as a measured source in numerical simulations of the most complex scenarios. The Link functions with a selection of computational electromagnetic (CEM) software.
With Insight, you can diagnose antenna radiation patterns with precise 3D views, calculate safety perimeters, investigate measurement setups. It allows for the detection of spurious radiation, and the possibility to extrapolate truncation areas. It's key feature today is the exporting of the source data for numerical computation. The EQC is a highly accurate source for numerical computations of antennas in a larger EM problem.

MEASUREMENT SERVICES

MVG offers antenna measurement services for stand-alone antennas and integrated antennas in wireless devices: mobile phones, laptops, IoT, Smart TVs, small satellites, etc.

Measurement systems in MVG test labs perform cylindrical or spherical near-field measurements based on multi-probe array technology. For passive antenna measurements, post-processing options include back projection and holography, allowing the determination of the field values at the aperture, or on a particular plane or radius.

As opposed to traditional single probe mechanical scanning, MVG technology is based on electronic scanning of an array of probes. This technology is faster, reduces mechanical movements, simplifies mounting, reduces setup time, and improves accuracy and repeatability.

From initial validation measurements for start-up projects to pre-compliance testing for standards certifications, you'll get fast and accurate results in any of the four MVG test labs located in facilities in the USA, France, and Italy.

MVG - Testing Connectivity for a Wireless World

The Microwave Vision Group offers cutting-edge technologies for the visualization of electromagnetic waves. Enhancing the speed and accuracy of wireless connectivity testing, as well as the performance and reliability of anechoic and EMC technologies, our systems are integral to meeting the testing challenges of a fully connected world.

WORLDWIDE GROUP, LOCAL SUPPORT

Our teams, in offices around the world, guide and support you from purchase, through design, to delivery and installation. Because we are local, we can assure speed and attention in project follow through. This includes customer support and maintenance once the system is in place. For the exact addresses and up-to-date contact information:
www.mvg-world.com/mvg-offices

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