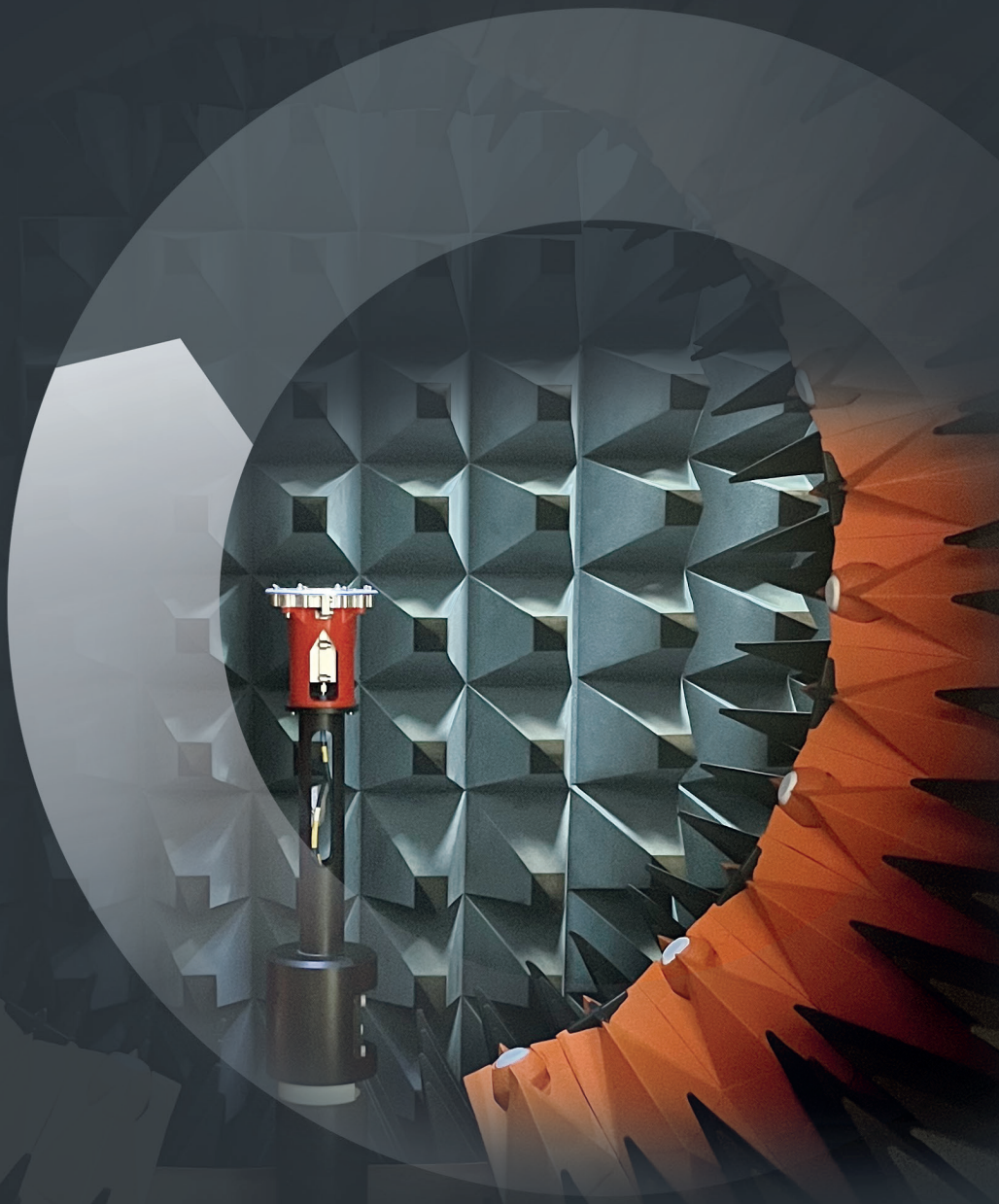
CASE STUDY

Using MVG Multi-probe Technology to Tackle Complex Antenna Characterization for a Satellite Feed Antenna

HPS
High Performance Space Structure Systems GmbH



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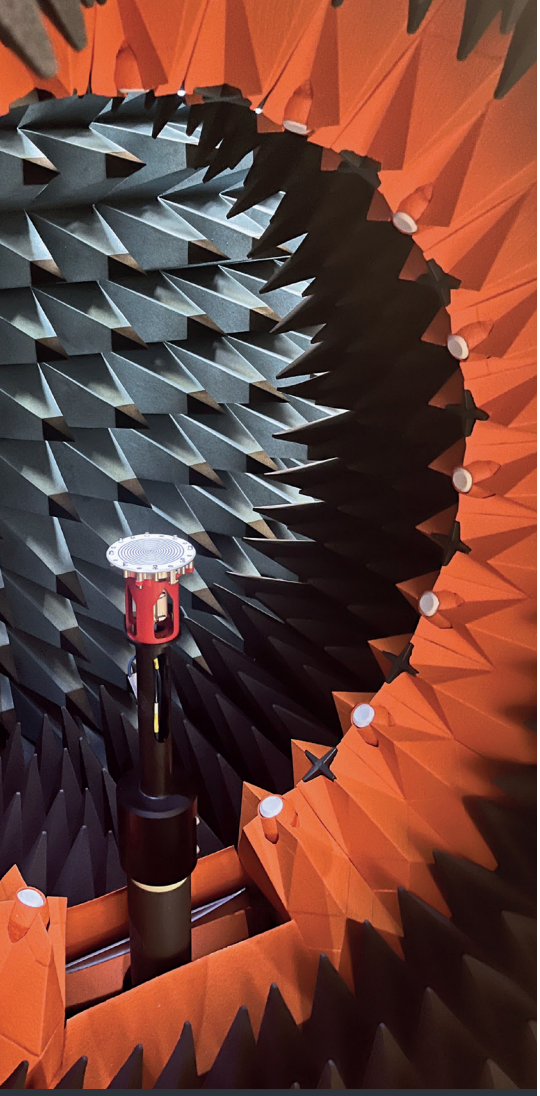
Dr. Ioannis Petropoulos,
RF design and analysis engineer at HPS-GmbH

mvg
Microwave Vision Group



INTRODUCTION

The market for data and intelligence to feed machine-learning and artificial intelligence (ML/AI) solutions has been aggressively expanding for years. There a wide range of potential applications for data that can be captured from open spaces, and a greater market for the intelligence that can be gleaned from this vital data. This is especially true for electronic emissions used for wireless communication and sensing applications around the globe.

In a bid to gather such data, a client approached HPS-GmbH, an industrial space subsystems specialist, to develop an antenna system for a satellite that can capture terrestrial emissions over a very wide bandwidth for a satellite-based remote sensing application. This is a similar challenge to characterizing a ground station antenna used to monitor satellites, with the exception that the client requested an antenna that can cover 2 GHz to 12 GHz.

Fortunately, HPS-GmbH's experts were referred to, and first sought the aid of MVG's testing solutions with an MVG multi-probe antenna test chamber and sophisticated antenna measurement software at hand. The measurement speed and accuracy of the MVG multi-probe antenna measurement system enabled HPS-GmbH's engineers to acquire the necessary antenna characterization data to confirm their models and proceed with their design in a fraction of the time and complexity the process had taken them in the past. As a result of the efficiency and precision of MVG's antenna measurement systems, HPS-GmbH experts had the confidence to move forward with a design ahead of their projected schedule without any delays.

HPS-GMBH TAKES ON A COMPLEX WIDEBAND FEED ANTENNA CHARACTERIZATION CHALLENGE

HPS-GmbH is the premier space subsystems specialist with over 2 decades of experience serving the industrial space community around the globe. This organization is skilled in developing turn-key subsystems for satellites or spacecraft, mainly large deployable reflectors, subsystem integrals, and individual elements of systems be it the mechanical, thermal, or electrical parts. The experience and solid track record HPS-GmbH has developed over the years, is precisely why their client sought HPS-GmbH's expertise in designing a reflector antenna solution for a satellite-based remote sensing application.

The biggest challenge associated with developing this antenna was to precisely capture the antenna performance and optimize the electrical parameters over a 10 GHz bandwidth from 2 GHz to 12 GHz. Having highly accurate measurement results over the entire frequency range is crucial in achieving a model that can be representative of the antenna's behavior in a simulation environment. "We needed this characterization data, so that we could proceed with a high level of confidence." Francesco Leone, an RF antenna engineer with HPS-GmbH shared, "This was a mid-stage effort to help compare our antenna model with real testing (i.e. we needed to determine the uncertainty of our antenna probe model)." Without an accurate model, the design process would be relegated to a matter of interactive testing of prototypes that could take months or years to optimize and at great cost. HPS-GmbH needed an accurate model of the antenna feed to aid in the design of the reflector structure, and ultimately, the complete reflector antenna design.

The challenge of characterizing an antenna over such a wide bandwidth arises due to the nature of the limitations of measurement hardware in most antenna measurement systems. Most antenna measurement systems rely on a single measurement antenna that is highly directive and presents well known antenna behavior. To achieve this with legacy measurement antenna design, it was generally necessary to limit the bandwidth of the measurement antenna to 1 or 2 octaves.

This means that to capture the performance of a 2 GHz to 12 GHz antenna, would require testing the feed over a 2-4 GHz, 4-8 GHz, and 8-12 GHz range, all with different test setups. Not only would requiring three different test setups result in some additional error and challenges with merging the data from each antenna measurement setup, but this approach would also require an extensive amount of chamber measurement time and convergence testing.

HPS-GMBH EXPERIENCES THE MVG ADVANTAGE

In the search for a more ideal antenna measurement solution, HPS-GmbH experts followed a lead from a friend with previous ties to MVG, who strongly recommended MVG's measurement technology for this challenge. After following through with the recommendation, Leone shared, "I was aware of MVG's existence, but I wasn't aware of how quickly MVG's antenna measurement technology could achieve such highly accurate testing."

The MVG location in Italy that assisted HPS-GmbH is dedicated to antenna testing, center, and design and development of reference antennas and measurement probes. Regularly performing tests in the MVG StarLab 50 GHz, a 650 MHz to 50 GHz multi-probe spherical and cylindrical near-field antenna measurement system to validate their own antennas, Andrea Faruolo, MVG Italy Sales Manager, explained, "We use an MVG StarLab 50 GHz for our own validation process. It is easy to see the advantage of using this system for our measurement services, as the results are generated very rapidly,almost in real-time."

Dr. Ioannis Petropoulos, an RF design and analysis engineer on this endeavor, added, "I appreciate the seamless process of viewing radiation patterns and boresight gain diagrams on the screen of the MVG lab computer. I can almost immediately compare them to previous measurements that I did in MVG, effortlessly seeing and evaluating the progress of our feed antenna. Additionally, the MVG personnel is well trained and flexible, providing us with experimental data in different forms, ie. Grasp format, Excel format, depending on our requests."

"The main selling point is MVG's electronic scanning and very wide frequency range with multi-probe technology."

Francesco Leone,
RF Engineer

After approaching MVG and experiencing its antenna test technology and measurement service, Leone explained, “Initially, we were curious about MVG and the StarLab 50 GHz, wanting to understand the principles and mechanisms of the MVG technology. All of the people there were very attentive and explained all of the functionalities. After the testing process was successfully concluded, the HPS-GmbH engineers received their data and confirmations on the accuracy of the data. “We also ran additional checks, and that even went super smoothly and very rapidly,” Leone detailed, “I was quite surprised; I couldn’t believe that it went so smoothly.” The results provided from the testing were more than adequate to validate HPS-GmbH’s model. “The main selling point is MVG’s electronic scanning and very wide frequency range with multi-probe technology.” Leone further elaborated, “For us, it doesn’t matter if it is mid-stage or final stage; those two selling points would be our main considerations comparing this facility to any others.”

HPS-GMBH NEXT STEPS & THE FUTURE OF THE SATELLITE-BASED REMOTE SENSING ANTENNA

“The next steps are to test the entire reflector antenna,” Leone provided, “Instead of using the MVG Starlab 50 GHz, however, due to size constraints we will likely use one of the MVG SG chambers.” The reflector antenna is much larger than the stand-alone feed, but a larger MVG chamber is able to accommodate the complete design and provide highly accurate measurements over the entire range in the same way as a smaller chamber. “The benefits of going with MVG in the future would be the same reason we sought out MVG for the mid-stage antenna development of the probe,” Leone shared,” We are looking for a huge reduction in measurement time and a quick turn around of the antenna measurement results along with qualitative confirmation and cross check verification in a matter of a few days. I only see this possible with MVG’s service and would likely have a very different experience at another facility.”