A New Compact Test Range for Satellite Antenna Measurements

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***Abstract* – For testing high performance satellite reflector antenna, a new 3.1 meters by 3.1 meter Compact Antenna Test Range (CATR) was designed, fabricated and installed in Taiwan. The range clutter levels are lower than -40dBc from X-band to Ka-band. High precision positioning system and software is shown to test a multiband and multi-beam reflector antenna.**

***Index Terms* — Compact range, Range clutter, Satellite Communication, Active measurement.**

I. INTRODUCTION

Taiwanese industry is a major supplier of Satellite communication antenna in the world. Planar near field antenna test range has been served well for antenna development, but is not able to test the system level performance integrated with receiver. A CATR is a good solution for both antenna and antenna system integrated with active module. This CATR was developed and installed by WavePro for Zinwell at Hsinchu Taiwan.

II. RANGE DESIGN

A parabolic reflector with proper edge treatment is the main component for a compact range. The design goal is to have a quiet zone size 150cm * 150 cm with X-pol level of better than -30 dB and amplitude taper of less than 1dB. A sample simulated Q.Z. is showing in Fig.1.

The chamber size of Zinwell CATR is 5m (W) by 5 m (H) by 12m (L). The operating frequency range is from 2.5GHz to 40 GHz.

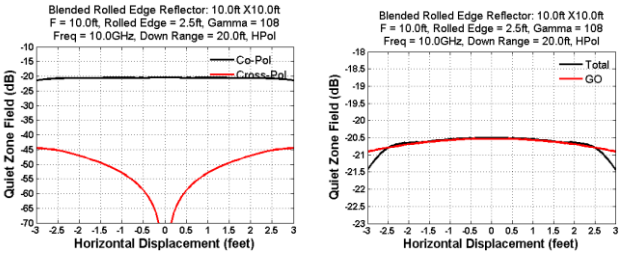

Fig. 1. Simulated quiet zone sample at 10 GHz.

Maximum surface contour mapping error for machining is 0.05mm at the edge as shown in Fig.2.

The CATR reflector was machined by AL-6061-T6 material and being mounted on a robust supporting structure.

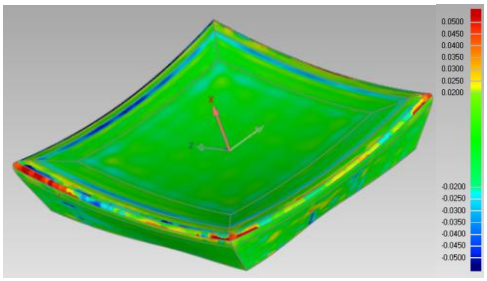

Fig. 2. Mapping contour for machining, unit in mm.

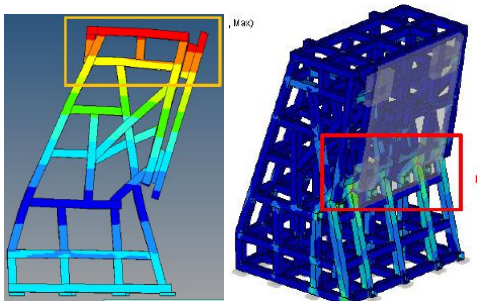

Fig. 3. Stress and distortion analysis of supporting structure.

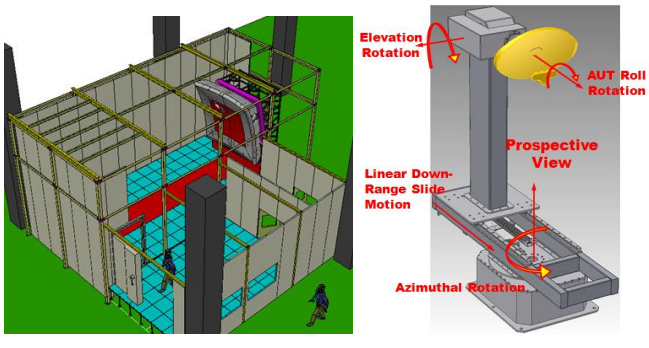

Fig. 4. Range Site planning and high precision positioning system design

III. ENGINEERING AND EVALUATION RESULT

A. *Installation of Zinwell CATR*

The total weight of CATR reflector with supporting structure is around 5 tons. A T-shape high strength steel meshed concrete isolation base was built for sitting the reflector and positioning system. The CATR reflector surface was smoothed to 1 mil rms surface error in parabola area. Mechanical installation accuracy was evaluated by a laser tracker. The modularized design feed antennas are located at focal point with several units that cover the desired bandwidth of operation.

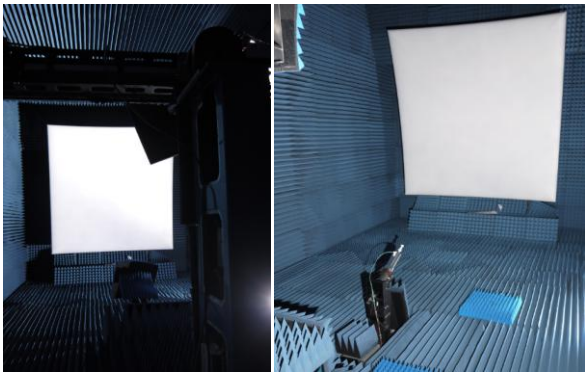

Fig. 5. Installed CATR at Zinwell.

B. *Zinwell CATR Quiet Zone Performance*

The quiet zone performance was evaluated via open-end waveguide probes carried by a linear scanner with flatness 0.03 mm. Sweep frequency Q.Z. fields are measured at both H-cut and V-cut. Range clutter images of TOA/DOA were processed from the sweep frequency data over the position span.

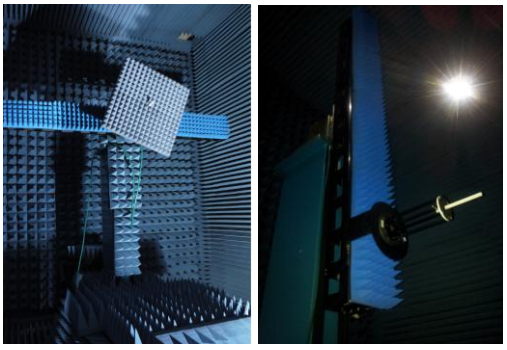

Fig. 6. Quiet zone scanning at horizontal and vertical cuts.

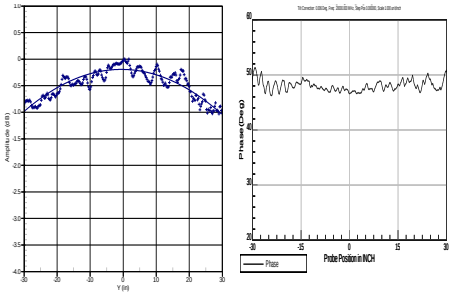

Fig. 7. Sample quiet zone amplitude and phase performance at 20 GHz.

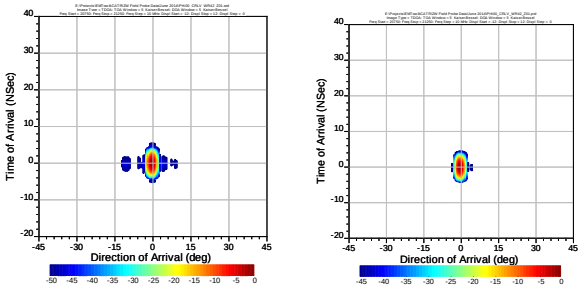

Fig. 8. Low level range clutters image at 20 GHz.

C. *Test Sample of a Satellite Antenna with ODU*

A customized measurement software was developed for testing antenna with ODU. The receiver is a spectrum analyzer with a software tracking on the IF signal while the drifting of LO signal in ODU. A sample pattern of a Satellite TV antenna/ODU with 1.343 degrees beam width is shown in Fig.9 .

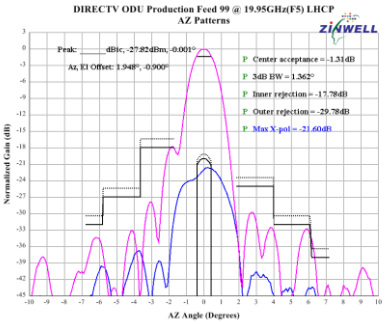

Fig. 9. Sample pattern of a reflector antenna with ODU at 19.95 GHz.

IV. SUMMARY

A high performance CATR built in Taiwan is presented. More evaluation results will be presented in the ISAP 2014.

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