Evaluation method for EMI anechoic chamber over 1 GHz using Optical Feed Broadband Antenna

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Abstract

We propose a bi-cone type antenna with photo-biased type photo diode and optical fibre link electromagnetic interference evaluation measurement system over 1GHz that consists of a transmitting optical fibre link system and a vector network analyzer. Our proposed system can measure $S_{21}(\omega)$ and $S_{21}(t)$ with the radiated electromagnetic interference measurement. We show experimental results of S_{21}s between our proposed bi-cone type antenna and a double ridged guide horn antenna by our proposed optical link system. It is proved that our proposed optical system can be used to evaluate the radiated electromagnetic interference measurement.

Keywords : EMI measurement over 1GHz, Time-domain, Optical device, Vector network analyzer, Microwave photonics, Comb generator

1. Introduction

We have already proposed an optical fibre link electromagnetic interference (EMI) measurement system that consists of a transmitting optical fibre link system, a receiving optical fibre link system, and a vector network analyzer [1]. Our proposed optical system can measure $S_{21}(\omega)$ and calculate $S_{21}(t)$ up to 10 GHz.

EMI measurement over 1GHz must be evaluate the site propagation characteristics of EMI anechoic chamber [2]. For this reason, we propose a bi-cone type antenna with photo-biased type photo diode and optical fibre link electromagnetic interference evaluation measurement system over 1GHz that consists of a transmitting optical fibre link system and a vector network analyzer.

In this paper, outline of our optical fibre link system is first explained. Next, some experimental measurement results are explained.

2. Outline of Our Optical Fibre Link System

Our proposed optical fibre link electromagnetic interference measurement system consists of transmitting optical-fibre link system and a vector network analyzer (VNA) or spectrum analyzer with signal generator. The transmitting system consists of a new bi-cone antenna with an photo-biased type photo diode module and a module of a microwave modulated laser light with a direct modulated type Laser Diode. The proposed system can be used to measure the S_{21} between a transmitting antenna without coaxial cable and a receiving antenna. Fig. 1 shows our proposed electromagnetic interference measurement system. Fig. 2 shows that the $S_{21}(\omega)$ of our transmitting module alone. In the case of output power of 10dBm at the port 1 of VNA, output power of photodiode is more than about -17dBm up to 10 GHz.

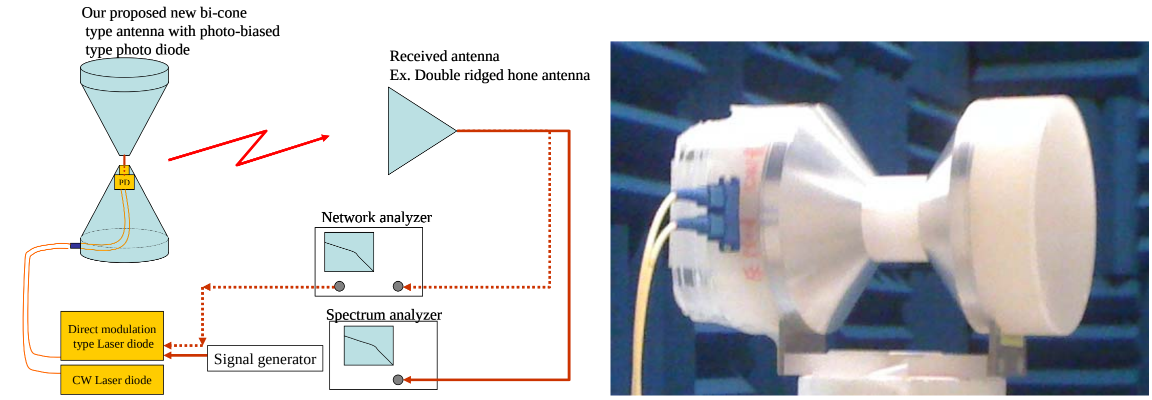


Fig. 1 Our Proposed optical fiber link system and photo of new bi-cone type antenna

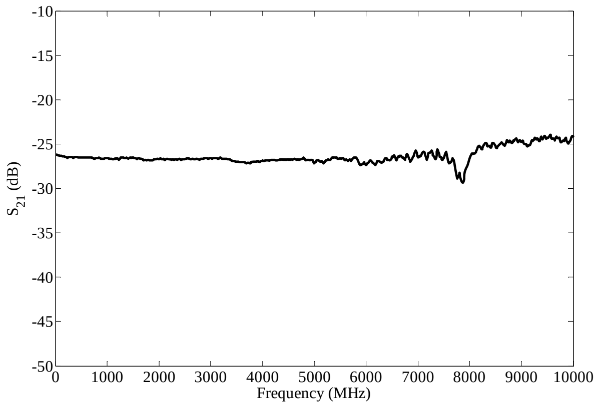


Fig. 2 $S_{21}(\omega)$ of the transmitting photo diode module

3. Outline of EMI site validation measurement setup over 1 GHz

3.1 **Measurement set up**

In order to evaluate the EMI site validation measurement over 1GHz, a transmitting new type bi-cone antenna and receiving model 3117 double ridded hone antenna of ETS-Lindgren Inc. are set 3m distance and 1m above the floor in an anechoic chamber with IS-SM050 absorbing material as shown in Fig. 3. The frequency domain $S_{21}(\omega)$s are measurement by a vector network analyzer (VNA) after a response calibration. The frequency range, the frequency interval, and the IF frequency of the VNA are from 10 MHz to 10 GHz, 10 MHz, and 100 Hz, respectively.

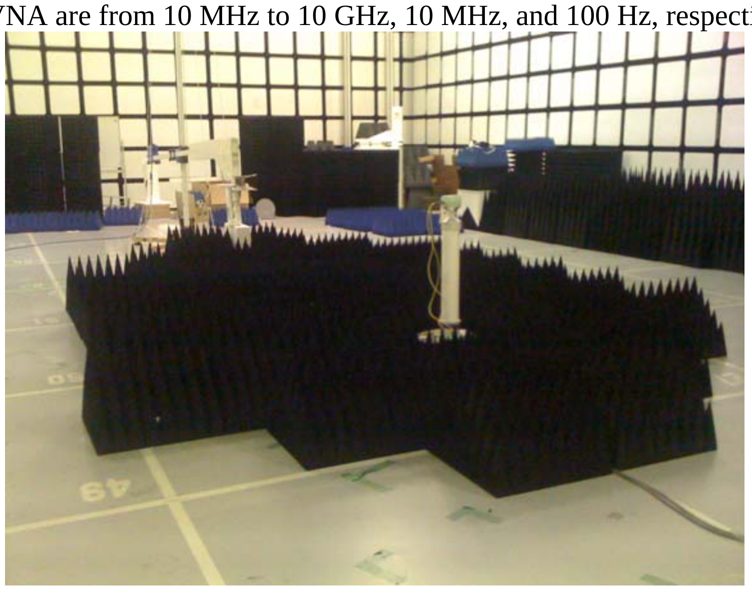


Fig. 3 EMI site validation measurement setup over 1 GHz

3.2 **Measurement results of vertical and horizontal polarization**

EMI measurement usually measures the vertical and horizontal polarization setting. Fig. 4, and 5 show the measurement frequency-domain $S_{21}(\omega)$s and the calculated time-domain envelope $S_{21}(t)$s, respectively. [Horizontal Pol.] and [Vertical Pol.] show the case of horizontal polarization and vertical polarization setting of transmitting and receiving antennas, respectively. In the case of ideal fully anechoic chamber, measurement results of horizontal and vertical polarization are completely same. However, compared with our measurement results of horizontal and vertical polarization, we have found that more than 2 dB difference around 2 GHz of $S_{21}(\omega)$ and more than 10 dB difference after 31.5 ns of $S_{21}(t)$ between horizontal and vertical polarization because the reflection wave from the absorbing material at the floor is difference. As is demonstrated here, it is possible to evaluate EMI measurement using our proposed optical fibre link system.

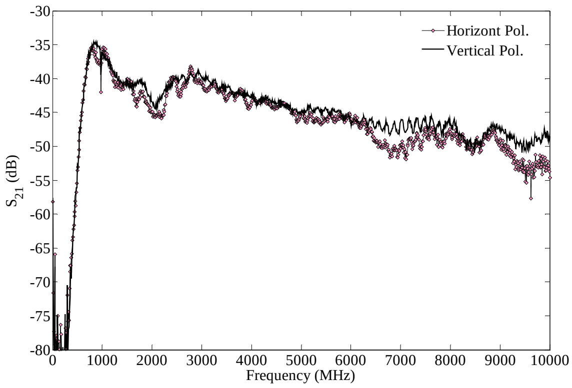


Fig. 4 $S_{21}(\omega)$ measurement results.

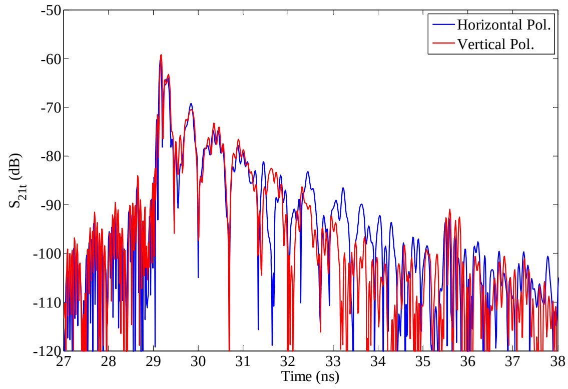


Fig. 5 $S_{21}(t)$ measurement results.

3.3 **Measurement results of antenna radiation pattern**

In order to evaluate the EMI measurement results, we carry out an antenna pattern measurement at horizontal and vertical polarization setting. Fig. 6 show the $S_{21}(\omega)$ measurement radiation pattern at horizontal polarization. Fig. 7 show the $S_{21}(\omega)$ measurement radiation pattern at vertical polarization. Fig. 8 shows measurement radiation pattern at another anechoic camber. Compared with these measurement results, we have found that some difference because the reflection wave from the absorbing material at the floor and walls.

As is demonstrated here, it is possible to evaluate electromagnetic interference measurement using antenna radiation pattern measurement using our proposed optical fibre link system.

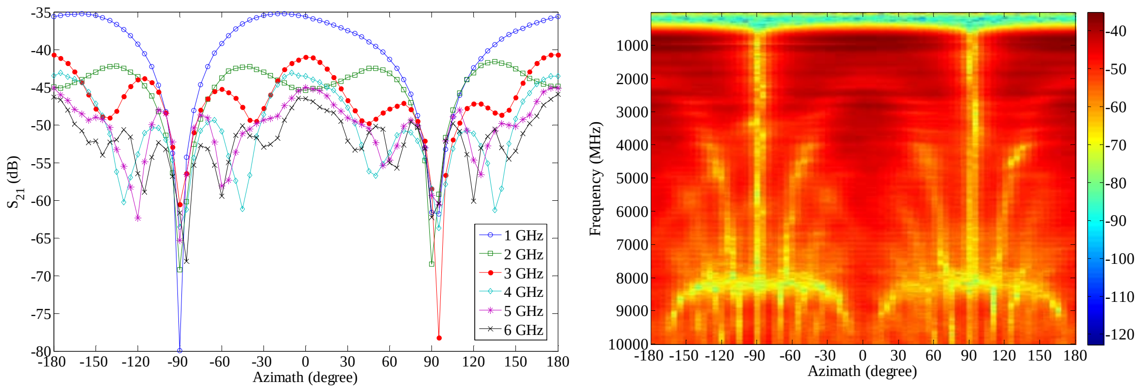


Fig. 6 Measurement radiation pattern at horizontal polarization.

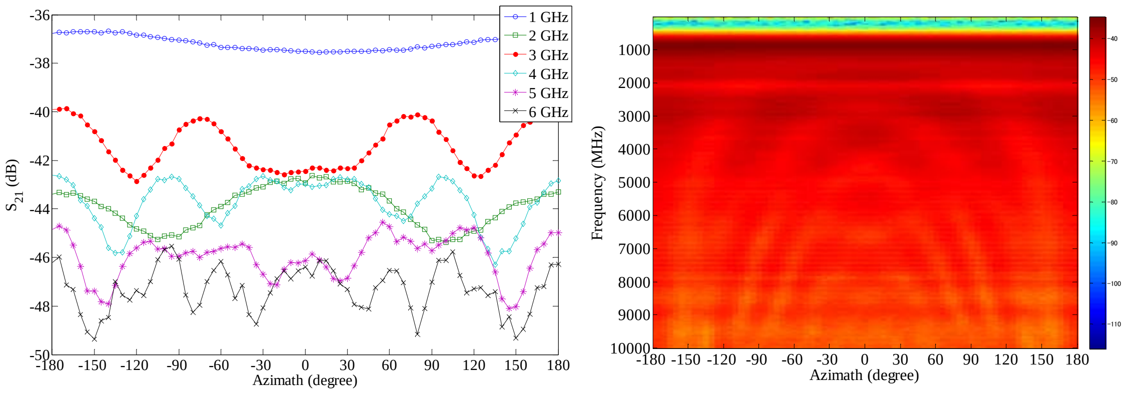
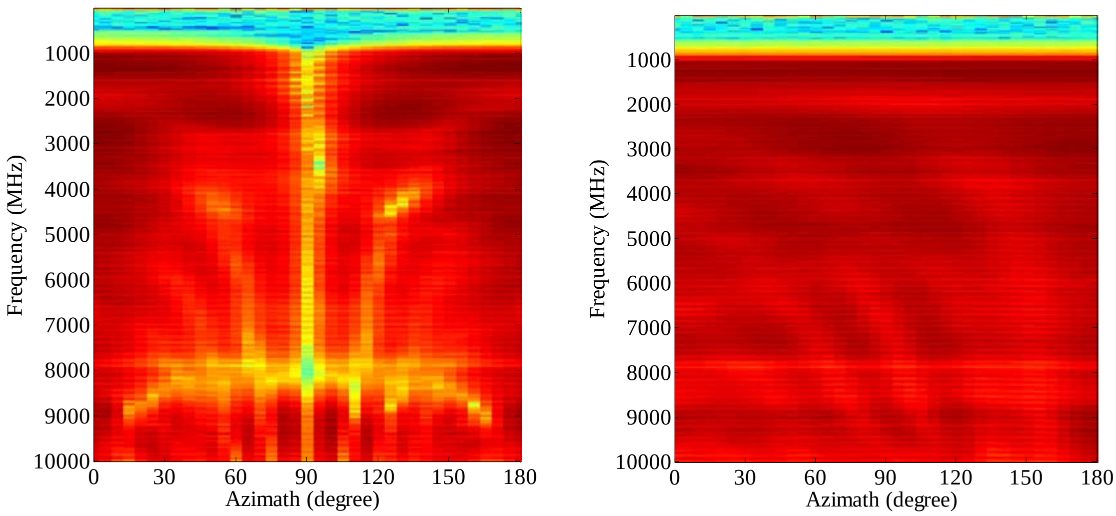


Fig. 7 Measurement radiation pattern at vertical polarization.



(a) Horizontal polarization result.

(b) Vertical polarization result.

Fig. 8 Measurement radiation pattern at another anechoic chamber

References

[1] S. Kurokawa, M. Ameya, M. Hirose,"A Novel Evaluation method for semi-anechoic chamber Using Zero Biased Optical Devices and time-domain analysis," in Proc. ICWIT 2010, 2010.

[2] CISPR 16-1-1 Ed. 2.0:2006, ``Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus.''