A study of compact lidar for industrial use

T. Higashikawa, T. Yokozawa

INC Engineering Co., Ltd, 1-15-18,Hyakunintyou, Shinjuku-ku, Tokyo 169-0073, Japan, t_higashikawa@inc.ihi.co.jp

ABSTRACT

We have developed a new compact lidar system without optical adjustment for observation of SPM (Suspended Particulate Matter) and plume from the smokestack. This compact system consists of a high power pulse LD and a refracting telescope and an APD module. We measured aerosol, smoke and hard target using this lidar system.

1. INTRODUCTION

In recent years, the company consciousness to an environmental problem is increasing and each company is coping with environmental pollution and improvement positively.

The lider attracts attention as an effective measurement system that can measure the particles and the smoke in three dimensions on real time. We have developed LD lider system which is easier than traditional lider system using the Nd:YAG laser. There are the following advantages by using the LD for the laser source.

1) Resistance to environment
2) Compact
3) Simplification of a system configuration
4) Maintenance free
5) Cost reduction

2. THE COUNTERMEASURES AGAINST BACKGROUND LIGHT REDUCTION

Because the background level is high in near-infrared region and spectrum width of the LD is very wide compared with the Nd:YAG laser, the measurement in the daytime of the lidar system using the LD is difficult[1].

Then, we took the following countermeasures, in order to reduce the background light.

① Spectrum width of a band path filter was made narrower.

② Insertion of an iris for decrease of stray light.

The spectrum width of a band path filter was designed 2~3 times larger than the spectrum width of the LD, because the LD had manufacture tolerance of the oscillation frequency. We matched the center frequency of the band path filter and the center frequency of the LD in the accuracy of ±0.5nm or less, and spectrum width was more narrowed. Moreover, we had used the iris for decrease of stray light that was scattering from inside of the telescope. By these effects, background light could have been reduced to 10% or less compared with improvement before.

Moreover we produced the differential amplification APD module in ordar to expand a measurement dynamic

Table-1 System specifications

Transmitter	Laser	**Pulse LD**
	Wavelength	870nm
	Pulse Energy	1.5 μ J@8kHz
Receiver	Detector	**Si-APD module**
	Gain	1～10MV/A
	Telescope	Refracting type
	Diameter	0.15m
Scaninng equipment	Elevation	-15～+60°
	Azimuth	±150°
A/D converter	Resolution	13bit
Software		INC Original

range. This APD module consists of two APDs that one detects signal + background light, another detects background light only. The differential signal of two detectors was amplified and transmitted to the A/D converter. Thus background light had reduced to the level measurable enough.

3. SYSTEM CONFIGURATION

The specification of the LD lider system is shown in Table 1, and the diagram is shown in Fig. 1. The lidar system consists of a 870nm pulsed LaserDiode with 1.5 μJ at 7.5kHz and a refracting telescope with 150 mm diameter. The collected scattering signal is detected by a Si-APD module. The scanning area of scanner is ± 150 ° in the horizontal direction. and –10～+60 ° in the vertical direction. The resolution of an A/D converter is 13 bits. The software is made by us, and it is equipped with each measurement mode of the PPI, RHI, and THI. Furthermore remoteness and automatic 24-hour measurement are possible for it.

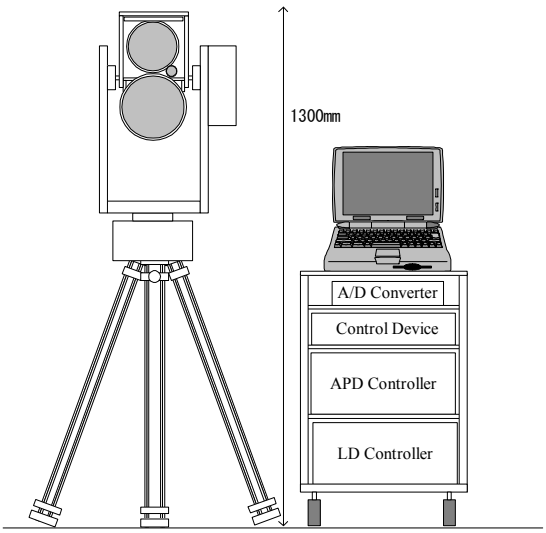

Fig.1 Schematic diagram of a LD lidar

4. Field Test

We had measured the plume from a smokestack for performance evaluation of the LD lider system. Measurement result is shown Figure2. The scanning area was 40° （4～44° ）in the vertical direction. The smoke generated from 170m point is going up to the altitude of 200m.

5. CONCLUSION

The countermeasure against background light reduction was performed to LD lider equipment first, and systematized. Moreover, we had measured plume from a smokestack at sight. Consequently, the 2-dimensional data of smoke was obtained. The further field examination will be performed from now on, and operativity will be improved.

REFERENCES

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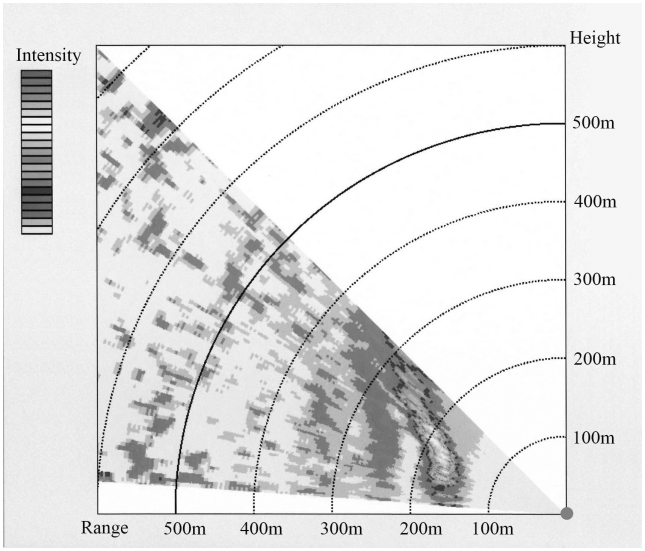

Fig.2 Result of smoke measurement