A METHOD FOR MEASURING THE STATISTICAL SPREAD-SPECTRUM DISTRIBUTION OF LASER BEAM PROPAGATING IN THE RANDOM MEDIAM **

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SUMMARY: A method was proposed for measuring the statistical spread distribution curves of laser beam. The techniques were found on the beam Width-Time-Amplitude conversion. With this technique the relative precision of the beam width measurement is of 1.3%(19 μm) in the turbulent air, and of 1%(14 μm) in the static air. When the laser beam passes through the rigion of flame of the alcohol lamp, the precision of the width measurement is of 2.7%(52 μm).

ABSTRACT: When a laser beam passes through the turbulent atmosphere, several effects induced by the turbulence would be formed. The main effects are intensity fluctuation, intensity distribution, the spot dancing and the beam spread. Under the condition of strong turbulence for the one of effects has attachment to the other, it is difficult to measure them separately. But in view of the physical measurement, the measurements of the intensity fluctuation and the distribution depend on the detection of light intensity and the position. And the spot dancing or the beam spread will be to determine the displacement or beam cross-section respectively. By using the displacement-Time conversion technique(Guan-Long Tan,J. Optics (Paris), Vol.12,4,241, 1981) the intensity of laser beam is converted into a train of photoelectric pulses, and the motions of laser beam passing through the atmosphere will be changed into the motions of the photoelectric pulses on the time axis. Thus the pulse amplitude, pulse shape(leading edge, fall edge and width) and appearing moment on the time axis are directly related to the effects mentioned above. If the variations of pulse amplitude and shape caused by the intensity change are eliminated or reduced to the least(G.L. Tan, ICL Digest, Guangzhou, China, 1983), then the pulse width is just the width of the beam cross- section expressed by the values of time . And the fluctuation of the appearing moment of pulses actually represents the motion of the spot dancing. Based on the measuring techniques of the spot dancing(G.L. Tan, IEEE/AP-S Digest, P843-850, 1985, Canada), it has been found the techniques of measuring the statistical spread sprectrum distribution curve. The method is as follows:

Firstly, using the high sensitive photoelectric detector, 3DU912, and the rotating slit system, the intensity of the

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laser beam is converted into a train of pulses. And the original photoelectric pulses coming from the detector are processed by successive limiter at a low photoelectric current. And so the output amplitude of the pulse from the limiter will be not varied with the change of intensity of the laser beam if the intensity is higher than that the value of threshold.

Secondly, we adopt the eliminating techniques to reduce the pulse shape variation to the least caused by the change of intensity of the beam.

Finally, the pulses their shape variations being eliminated to the least are fed into the pulse Width-Amplitude converter. From which the pulse are delivered to the multi-channel analyzer. And the statistical distribution curves of the beam spread and the statistical parameters are finally obtained.

The experiments shown in block diagram Fig(1), were carried out. A colimated laser beam with cross-section of 3mm × 8mm passed through the experinental box of the length 74cm, and then arrived at the photoelectric detector. At the receiving point there was a rotating system with speed adjustable and stabilized, and rotating frequency was of 29 Hz. It had been tested the statistical distribution curves of beam spread under the conditions of static air, turbulent air and of hot turbulent air. Especially, we finished the experiment, the laser beam passed through the region of flame of alcohol lamp. The experimental results were shown in Fig(2) and Fig(3).

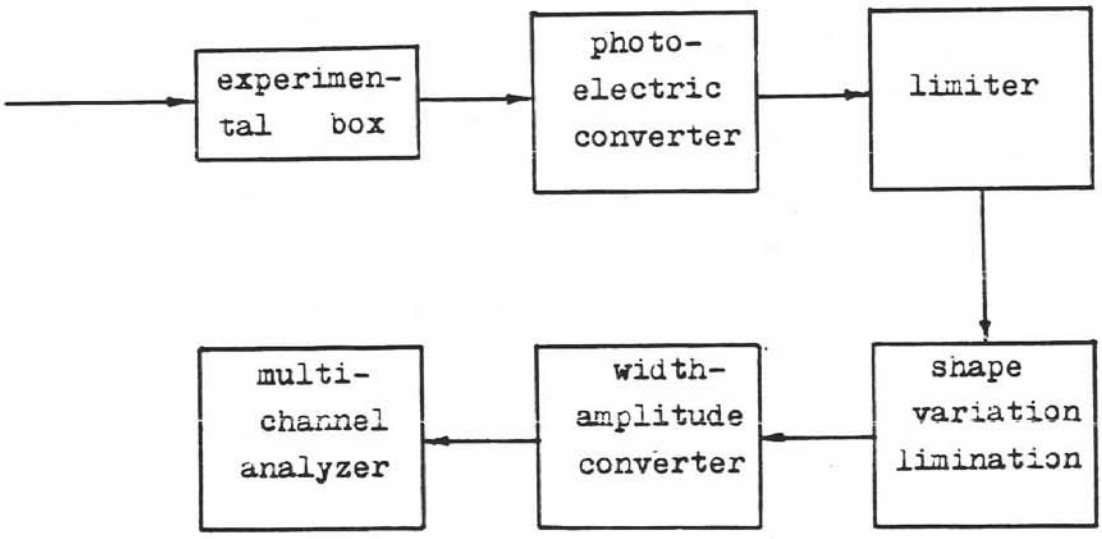
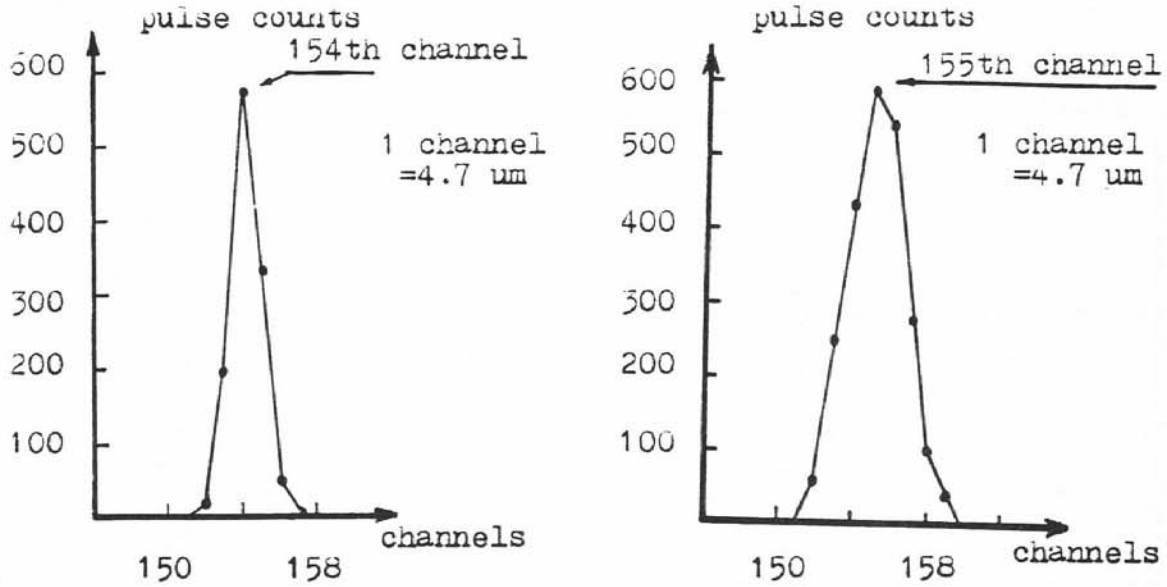


Fig.(1) Block Diagram Measuring Beam Spread



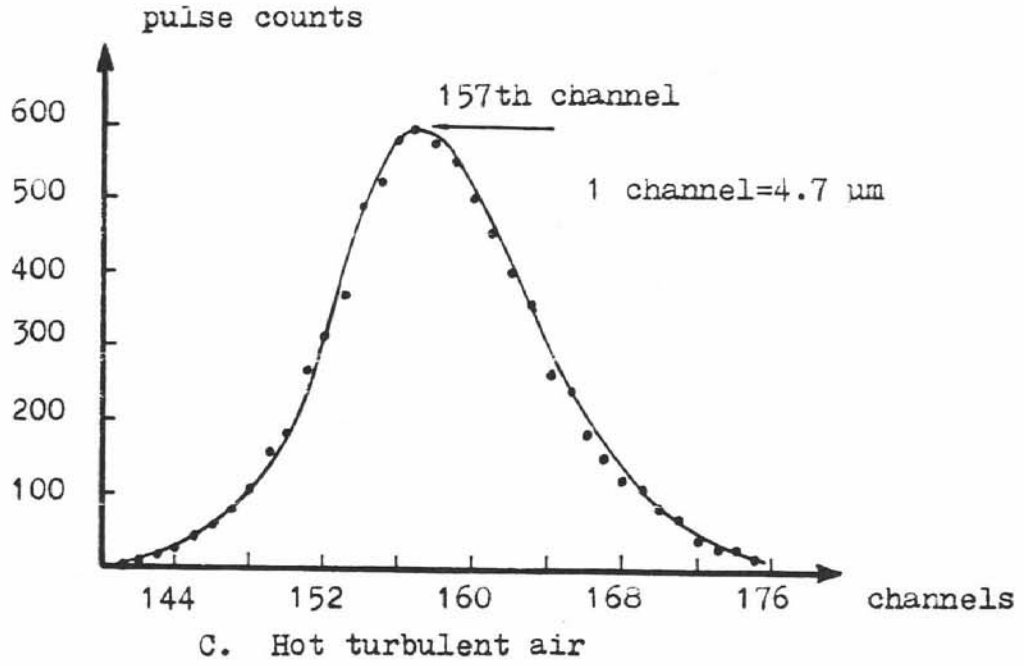


Fig.(2) Beam spread Distribution

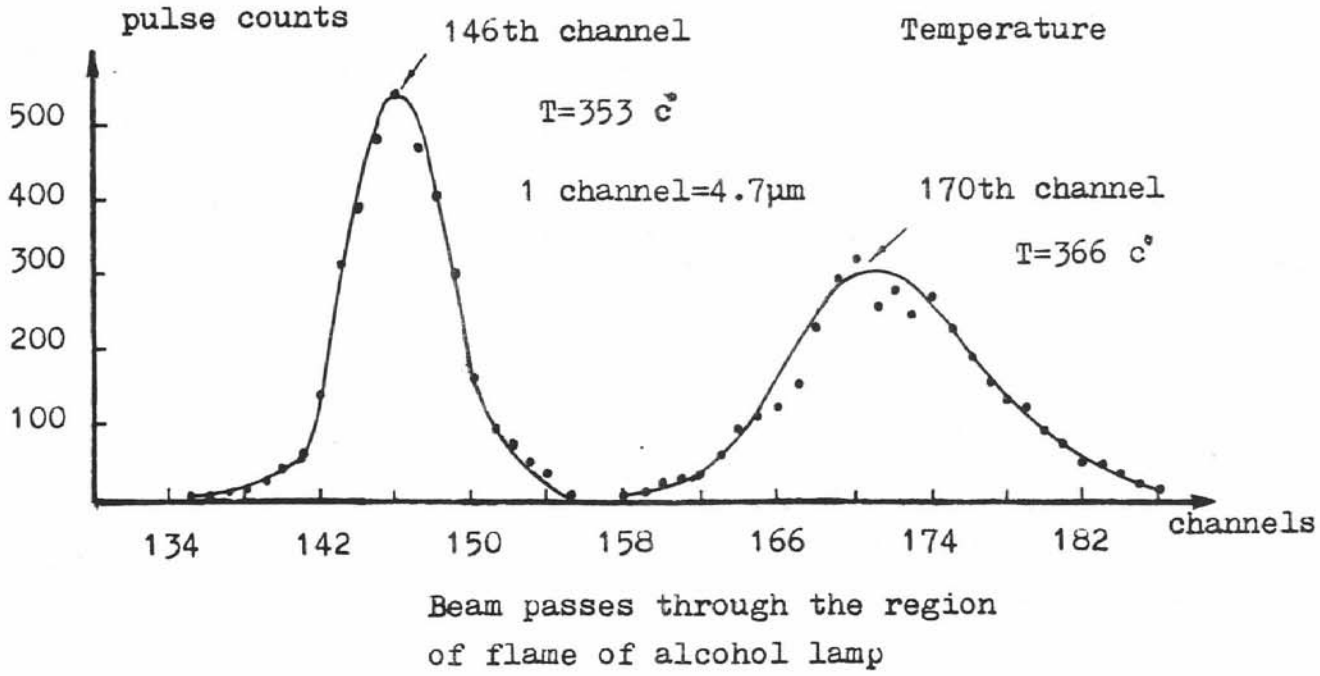


Fig.(3) Beam spread Distribution