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Observation of wind-driven rain and wind-borne debris of tall buildings based on LiDAR technology

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ABSTRACT

The wind is a kind of gas movement caused by the difference of atmospheric pressure, which plays an important role in the research of water cycle and the field of building safety. Wind will affect the size, speed, distribution and range of raindrops, which can be studied by numerical simulation method, laboratory test method and meteorological observation method. At the same time, the debris generated under extreme wind conditions is the main source of damage to the building environment, which is mainly studied by wind tunnel experiment method and numerical simulation method. Traditional wind tunnel experiments have shortcomings in accurately simulating turbulence and solving scale problems under real atmospheric conditions. Numerical simulation methods have certain limitations in computing resources, model complexity and initial parameter sensitivity. In recent years, domestic and foreign scholars have studied the feasibility and potential of coherent Doppler lidar (CDL) in precipitation detection and wind-borne debris observation. CDL makes use of the principle of optical Doppler shift between the reference and backscattered radiations to measure radial velocities at distances up to several kilometers above the ground. Compared with traditional methods such as numerical simulation, wind tunnel test and in-situ observation, lidar has the following advantages in wind and rain field observation and wind-borne debris observation: it has extremely high spatial and temporal resolution and can accurately measure targets at different heights and distances; it has the ability of multi-parameter observation and can provide comprehensive information of atmospheric parameters. It can provide the distribution of atmospheric parameters in three-dimensional space; it is easy to install and can achieve long-term continuous monitoring. However, it also faces some challenges, just like the signal attenuation of CDL in precipitation weather is faster than that in clear sky, and the observation distance is limited. It is expected that future development of the CDL technique and data processing algorithms will provide accurate measurements with wind-driven rain and wind-borne debris of tall buildings.

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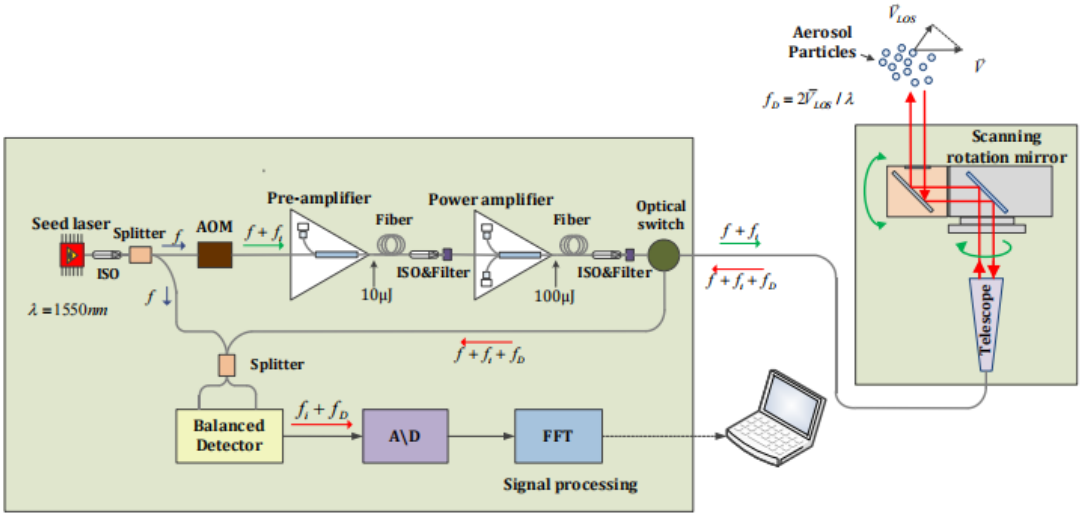

Fig. 1 Coherent Doppler LiDAR working principle schematic

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