Development of a Fast-Scanning LiDAR System with High Spatial Resolution

Liam Sutton, John Holdsworth, Dusan Ilic, Kenneth Williams and Craig Wheeler

College of Engineering, Science and the Environment, University of Newcastle, Newcastle, 2308, Australia

Regulatory measurement [1] of atmospheric particulate matter (PM) relies on a small number of fixed-point detectors [2] around locations of interest, at close to ground level. A fast-scanning LiDAR system has been developed to measure dust plume presence over a much greater atmospheric volume. The system incorporates a < 1 ns pulsed 355 nm UV source laser and a 355 mm aperture receiver telescope with sensitive detection to provide three-dimensional visualisation of PM plumes with a range resolution of 1.5 m and an acquisition time per single direction of less than 1 second. The design avoids the shortcomings of current commercial LiDAR systems with 10-30 s single direction acquisition times, slow mechanical movement of the turret and a 25-40 m range resolution.

The system has been field tested overlooking a chemical manufacturing plant in Newcastle, NSW known to have water vapour and smokestack plume emissions [3] with results shown in Figure 1. Each horizontal line of this scan represents the signal acquired in 0.7 s, averaging ~700 laser pulses. Hard target returns are circled in yellow while diffuse plume media returns from a range of 1.12 km - 1.17 km are circled in red. The new LiDAR is the only means of measuring the presence of particulate matter with this definition at distance and elevation.

![Figure 1 Contour map of LiDAR data showing hard targets in yellow circle and a water vapour plume in the red circle. Scan (y-axis) consisting of ~700 laser pulses and range (x-axis) ranging from 1-1.45km.](image)

