VELOCITY AND CONCENTRATION MEASUREMENTS OF A STACK GAS DISPERSION IN AN ATMOSHPHERIC BOUNDARY LAYER

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The main purpose of this research is to manage simultaneous measurement of velocity and concentration in large cross sections (0.3m × 0.4m) where images of cloud structures instead of the individual particles are recorded. Stack gas dispersion in an atmospheric boundary layer (ABL), is chosen as the test case and investigated both experimentally and numerically.

Large scale particle image velocimetry (LS-PIV) is used to have the velocity field information. Different seeding configurations are tried (e.g. seeding only from the stack, Figure 1) and compared. It is found that, upstream seeding is enough, if the region close to the stack is not particularly important for the research. To improve the estimated average velocity field, a technique called, signal-to-noise-ratio filtered averaging is employed. This method proves its usefulness, specifically in the region close to the stack where signal-to noise ratio is lower due to excessive seeding.

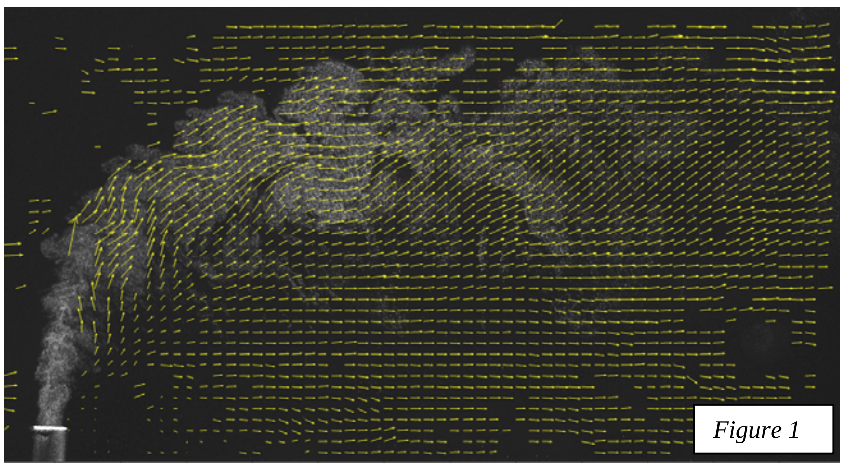
Figure 1

Light Scattering Technique (LST) is employed to measure the concentration of the pollutant. The adverse effect of non-homogeneous illumination sheet is successfully eliminated. A non-linear relation between the scattered light and concentration is found and a preliminary study for a correction function is performed (Figure 2).

A detailed theoretical and experimental study on aspiration probes is performed, including the comparison of different tracer gases. Aspiration probe results are compared with LST measurements.

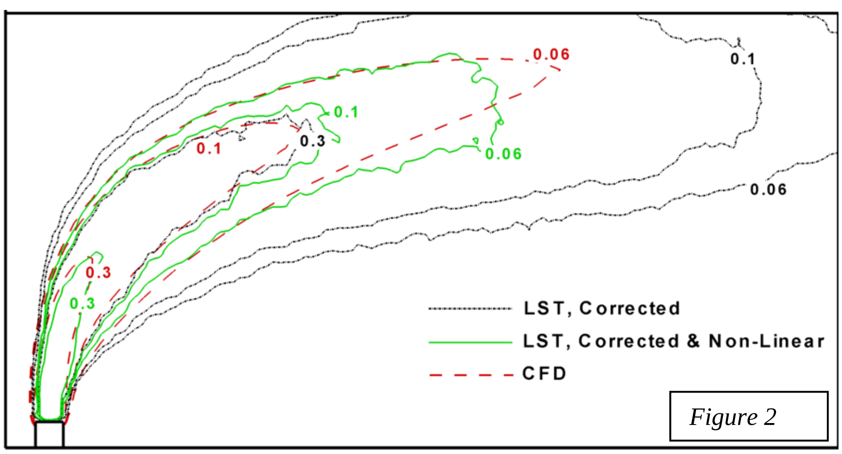

Figure 2

Existing ABL in wind gallery facility is investigated and all the essential parameters; velocity and turbulence intensity profiles, as well as integral scale are determined.

In the numerical part of the project, first a parametric study in a 2D domain with different wall functions is performed to simulate a horizontally homogeneous ABL. Subsequently, with the validated ABL, the stack gas dispersion is simulated in a 3D domain. Velocity and concentration profiles are compared with the PIV, LST and aspiration probe measurements.