Master's thesis project in optical remote sensing

Designing, building and testing a mobile doppler wind LIDAR

Figure 1. Left: The Chalmers solar occultation flux method which today is a European standard how to measure diffuse gas leakages of volatile hydrocarbons. Middle and right: a commercial stationary wind LIDAR (Light Detection and Ranging) measuring the 3D wind.

Background

Chalmers has developed several unique mobile optical remote sensing techniques for quantification of diffuse gas emissions from for instance industries, farming and volcanoes. These techniques are becoming a standard on how to measure diffuse gas emissions of volatile hydrocarbons (alkanes, alkenes, alcohols etc) and they are for instance being used in California, China and Europe.
See: https://sverigesradio.se/sida/artikel.aspx?programid=104&artikel=7066876
A common problem in all these applications is that we need information on the speed and direction of the wind in the gas plume we are monitoring. As the location of this gas plume is often inaccessible due to high elevation or geographical constrains. One attractive option here is to use laser measurements to measure the wind, by measuring the Doppler shift in back reflected light on atmospheric particles. In the solar occultation flux (SOF) method, gas measurements are done in a mobile way and our idea is to build a simplified LIDAR (Light Detection and Ranging) system that will be used on the same platform as the SOF to measure the wind. This would greatly improve the SOF technique since real time wind would be available at the right position.

What is the project about?

The main objectives of the work are:

- Design a 1-D wind LIDAR system and order components
- Model the system and the optical radiative transfer.
- Build the LIDAR system and test for stationary measurements. Work will include electronics and software plus the development of a retrieval software.
- Adapt the LIDAR-system to work in mobile mode on a SOF vehicle and test/demonstrate by doing real measurements on a refinery. Compare to mast wind measurements and balloons.
- Data analysis, and reporting

The main outcome of this important work will greatly improve the usage of the optical techniques applied by Chalmers and other scientists for a full suite of environmental measurements.

Requirements

- experience with electronics
- programming experience (matlab, python and C)
- ability to solve practical problems.

Supervisor

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