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Electric Field Sensor for Small Unmanned Aerial Vehicles

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Characterisation of the vertical variation in the atmospheric electric field has been made for many decades, but normally in an ad-hoc manner, using instrumented weather balloons or manned aircraft, which are expensive to fly. Such vertical measurements are required to measure the ionospheric potential and to characterise electric fields with clouds (both thunderstorm and non thunderstorm clouds) to understand the charging processes within them.

Advances in electronics and battery technology has meant that small Unmanned Aerial Vehicles (UAVs) have now become available as a new science platform. These measurement platforms address many of the problems associated with manned aircraft while allowing in-situ measurements with an increased level of control and repeatability when compared to weather balloons. Despite their potential advantages, one of the main challenges to using UAVs for atmospheric electricity research is the lack of small, lightweight sensors which are commercially available. To overcome this barrier, this work describes the development of a lightweight, miniaturised electric field sensor to be integrated with a small UAV (<7kg, wingspan 2m).

The sensor has been designed to allow measurements of the electric field intensities typical of non-thunderstorm low altitude (<6000 ft) clouds with a typical range of 0-2.5kV/m. It is based on the concept of an electric field mill, but with a translational shield rather than a rotating vane model. This allows the sensor to fit neatly within the wing of a small UAV, rather than the need to be mounted in the nose. A custom designed 3D printed housing contains all elements of the sensor package, with the translational shield movement and data logging controlled by an onboard programmable microcontroller. This work will focus on the details regarding the experimental characterisation of the sensor package with a particular focus on the key influences of the integration with the airborne platform.