Meteo Sensors In the Sky ('METSIS')

Summary

Because of their light-weight nature, **drones can be vulnerable to wind**. This is particularly the case at low altitudes where both wind speed and direction can change abruptly. However at present, real-time and accurate knowledge of low altitude wind information is limited, especially in **urban areas**. This limitation makes it difficult to realize the numerous anticipated applications of drones in urban areas, such as aerial photography, mapping and package delivery.

As a step towards addressing this problem, the **Meteo Sensors In the Sky (METSIS)** project proposes to test the use of drones as a wind sensor network for **hyper-local wind now-casting at low altitudes** (<1000ft). The METSIS concept consists of three steps. In the first step, instantaneous wind speed and direction measurements are downlinked to the ground by airborne drones. Subsequently, a ground station aggregates the wind data from the individual drones, and uses the **Meteo Particle Model** (MPM, developed by TU Delft) to estimate a **3D wind field vector map** over the sensed area in real time. In the third and final step, the 3D wind field information is communicated to drone operators via **U-space**. This wind information can be used for determining unsafe no-fly zones, as well as for flight planning purposes.

To validate the METSIS concept, **NLR and AirHub B.V.** will jointly perform **experimental drone test flights**. The primary objective of the experiment will be to investigate the accuracy of the method for a variety of situations, including near **static obstacles**. To verify accuracy, MPM estimated wind speed and direction at several locations will be compared with those determined by a reference drone (i.e., a separate drone that does not contribute to the measurement network). The **Royal Netherlands Meteorological Institute** (KNMI) will take part in an advisory capacity to ensure that wind measurements are taken correctly.

Additionally, this project will address how the wind field data can be used within a **practical U-space system**. To this end, AirHub B.V. will interface their **Drone Operations Centre** software with the 3D wind field data generated by MPM. AirHub will focus on how the wind data can be communicated and visualized to drone operators in an effective and seamless manner, taking into account the other data that is needed for drone flights (e.g. airspace constraints).

Using this approach, the output of the METSIS project will directly help companies such as AirHub to add operationally relevant functionality to their product offering. Furthermore, by considering all three steps of the METSIS concept, this research will mature the corresponding technology **from TRL 2 to TRL 6** within the scope of a single project. Therefore, METSIS will contribute in the short term towards the realization of a low-altitude wind now-casting system needed to enable drone applications in urban contexts.

The METSIS concept offers several technical and practical advantages. For drone operators, the METSIS approach has the potential to not only improve **safety**, but also improve flight **efficiency** as wind can significantly affect drone battery life and/or range. Additionally, in comparison to other approaches that make use of a dedicated measurement infrastructure, the METSIS concept represents a relatively **low-cost solution** as the drones themselves provide the required wind measurements. This further strengthens the potential commercialization of the METSIS concept. Beyond drones, this approach for low-altitude wind measurement can also be applied to other areas of the aerospace industry, for instance for Shipboard Helicopter Operational Limitation (SHOL) analysis. Finally, METSIS has **broader societal applications**, e.g. safety of construction, and as an additional input to national meteorological forecast systems.

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