

UAV Radio Communication Modeling for Digital Twin Inclusion

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In this work we present a flexible methodology for the modeling of UAV (Unmanned Aerial Vehicle) radio communications for its inclusion as a radio link module on a Digital Twin (DT). The main purpose of implementing and integrating this module is to characterize and assess the communication link and to foresee conflicting issues due to distance, the environment, the positions and orientation of the aircraft relative to the pilot, and other phenomena. The module is based on an experimentally obtained Path Loss (PL) model during flights and drone-antenna radiation patterns obtained by means of full wave electromagnetic simulations performed with CST Microwave Studio software. This approach allows modeling the Radio Frequency (RF) link between a UAV and its controller. The presented work focuses on implementing a specific drone (an hexacopter), antenna and payloads (No payload, LiDAR and a Jetson), but it is important to note that the developed methodology is easily adaptable to different aerial platforms (drones and their structural materials and payloads), environments (e.g. sub-urban, agronomic), antenna type and its position on the UAV, radio propagation models, etc. Finally, the simulated flight results showed agreement between the estimations and the PL measured during the experimental flights, validating the presented methodology to be implemented for a Digital Twin setup.

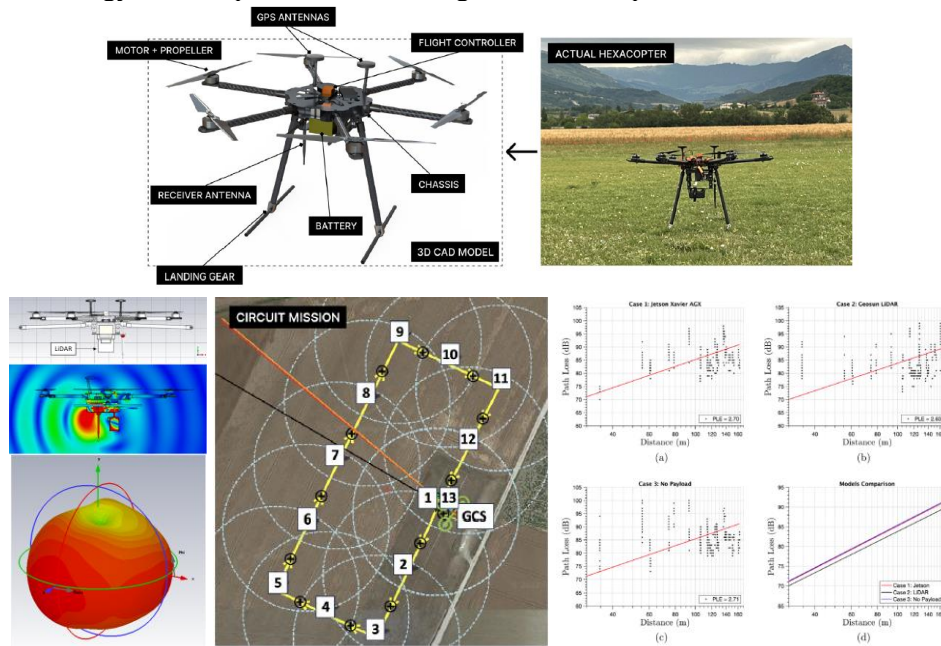


Figure 1. On the top left, 3D rendering of the hexacopter CAD model with landing gear deployed and no payload attached. On the top right, picture of the actual hexacopter during the experiments. On the bottom left, CST Microwave Studio simulation results for a flying hexacopter with a LiDAR as a payload. On the bottom center, schematic view of the circuit mission with the waypoints. On the bottom right, PL values and CI Model fit for the three different payloads: (a) Jetson Xavier AGX, (b) Geosun LiDAR, (c) No payload, (d) Comparison between the three cases.