

Bistatic FMCW Based Ground Penetrating Radar for UAV Application

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Ground Penetrating Radar (GPR) is an essential tool for the detection of landmines. State of the art GPR systems are either mounted on vehicles or used as handheld devices, however encountering the problem, that mine fields have to be entered for mine detection. To overcome this limitation, a broadband Ground Penetration Radar sensor system that can be operated on an unmanned aerial vehicle (UAV) has been developed.

The bistatic GPR sensor system consists of a 1-4 GHz FMCW radar module and two broadband antennas. The selected frequency range results from requirements regarding ground penetration and resolution in combination with the size and weight of the antennas. The sensor module is partitioned into a main module and a receiver module. The architecture of the main module exhibits the broadband

frequency synthesis, power supply, data acquisition as well as a communication interface for configuration and data logging. The receiver module is a separate unit, which can be directly mounted on the receiving antenna. The architecture and the partitioning of our sensor system will be presented in this contribution. Challenges with respect to power consumption and broadband operation will be discussed.

Two different types of linearly polarized broadband antennas have been simulated, manufactured and characterized: A logarithmic periodic dipole antenna (LPDA) manufactured on a low cost PCB and a transverse electromagnetic (TEM) horn antenna. The latter antenna consists of a thin conductive layer which is mechanically supported by a 3D printed plastic structure. The RF-characteristics



of these antennas with respect to mutual coupling in the bistatic sensor and regarding the shift of the phase center in such a broadband system will be shown and discussed. Furthermore, challenges and solutions regarding the application on an UAV will be highlighted.

Finally, free space measurements with the Ground Penetration Radar system will be shown and the overall system performance will be discussed and benchmarked.