UAV based mobile platform for wireless sensor data collection, aggregation and terrain mapping and imaging

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Abstract

Today utility of the UAVs, or drones, as an airborne mobile platform is typically limited to the aerial video recording, photography and entertainment. The ability of such small and relatively affordable machines to cover large areas of land in flight is an open research topic.

The popular methodology of modern natural resource exploration is seismic data analysis. This procedure requires a number of special seismic sensors to be deployed on a particular area of interest, with the accuracy of the received data to be dependent on the sensor deployment density. As a result, the reliable seismic study requires very large-scale sensor data collection and analysis. Further, if the sensors are not designed for wireless communication the manual data collection is needed, and in the case of large-scale high-density sensor network it quickly becomes major bottleneck in a resource exploration operation, or require additional infrastructure in case of the wired sensor modules. An obvious alternative is to deploy wireless sensor network, however, in large-scale wireless network it is hard to guarantee the stable behavior, due to the probability of synchronization, timing errors, cross-node interruptions and noise. In addition, if the region of investigation can be segmented, UAVs can be used to locally collect the wireless sensor data and transmit it to the central server (Figure 1 & 2). The drone can carry small processing unit onboard, such as Raspberry Pi microcomputers, in order to perform local data preprocessing and reject redundant or unnecessary data, thus reducing the overall volume of the raw sensory data to be analyzed. Multiple UAV units can be synchronized to operate simultaneously to cover more regions at once.

As additional benefits, drones can be utilized in more traditional way – providing the conveniently obtained graphical information about the exploration site, which can be used as a valuable supplement to the sensor data in order to build accurate terrain map and 3D model. Moreover, this framework can operate in real time, thus providing immediate response.

Autonomous operation in the different weather conditions is the natural issue related to this application of the UAVs. However, accurately selected and tuned control system and drone component can greatly mitigate the possible effect of the unwanted wind, snow and rain. Finally, the proposed framework is oriented to be developed as an open source project, from wireless smart geosensor design to UAV control, thus welcoming further contributions and development.

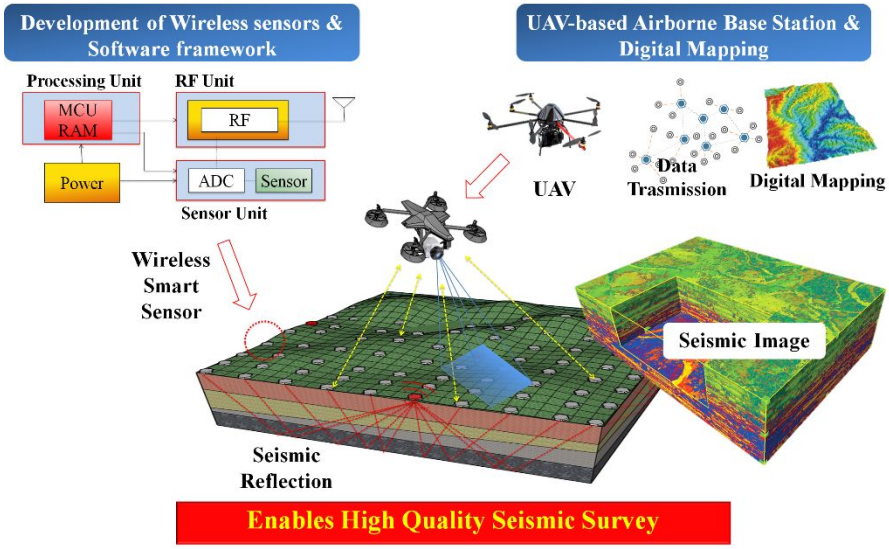

Figure 1. Proposed UAV sensor framework

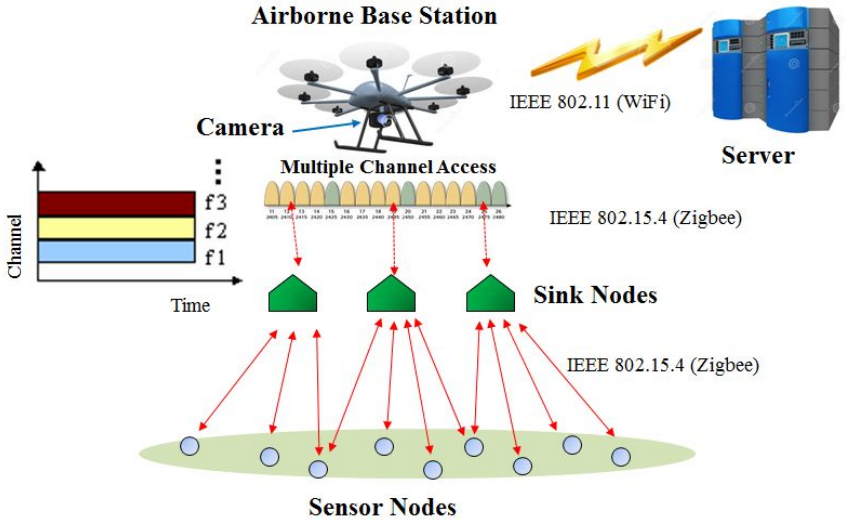

Figure 2. UAV as a local base station.