Viewshed Analysis for UAS Flight Planning

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ABSTRACT:

In this project, we developed a mapping algorithm to identify observer locations in planning for Unmanned Aircraft System (UAS) surveys. This algorithm can be used to ensure safety of all participants and bystanders during active surveying and to maintain compliance with Federal Aviation Administration regulations for safe drone operation. These regulations require that ground crews maintain visual line-of-sight with the drone during flight. This safety precaution is especially relevant when flying in densely populated areas with visual obstacles, like buildings and tall vegetation. We used the University of Texas at Dallas (UTD) as a study site for the development of this algorithm as part of our smart campus project. The UTD campus covers 200 hectares with clusters of buildings and facility structures assembling an urban landscape. Using lidar data, we developed a digital surface model of UTD that details the structure of buildings, tall trees, and other obstructing features. This model was partitioned into survey areas to accommodate UAS flight time constraints. Based on the digital surface model, we applied viewshed analysis in relation to the planned flight paths to examine potential observer locations and cumulative viewshed across each survey area. For each area, the number and locations of observation stations necessary to maintain constant visual contact with the drone throughout its flight were identified. This was accomplished using a Python processing algorithm, which selects ideal observers from valid ground locations visible along the fight path until total coverage is achieved. The resulting algorithm determines the minimum number of stations required to maintain the line-of-sight and the locations of these stations. Additionally, the portion of the drone's flight path visible to each ground observer is mapped, delineating zones of observer responsibility. These findings assure an effective distribution of ground crews to maintain UAS safety and FAA compliance. Comparable lidar survey data are now available in many urban areas where maintaining visual line-of-sight presents a critical issue for UAS surveys. This algorithm may facilitate the planning and assessment of observation stations in future UAS surveys using similar datasets. This assessment may be used as a supplement to FAA waiver and airspace authorization applications and reinforces the safety precautions that UAS operators should undertake when requesting such exemptions.

KEYWORDS: UAS; Viewshed; Smart Campus; Python; Lidar

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