The Uses of SUAS in the Surveying Industry

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Abstract

Small Unmanned Aircraft System, more commonly known as drones or UAVs, have been more and more popular in the last five years because of SUAS's technological development. The door is open wide for the surveying world, and SUASs provide a faster and cheaper alternative to airplanes. When surveying in the field with SUASs, even small projects can even have a birds- eye view instead of collecting data points by hand with a total station. SUAS allows for quick modeling of small and large surveying projects. The use of SUAS will enable surveyors to use photogrammetry and other drone systems to create two-dimensional and three-dimensional Orthomosaic maps. Three-dimensional models, Thermal maps, Lidar mapping, Multispectral maps, and Topographical maps. These maps and data collection methods help represent a project throughout a job from the beginning to the end. The modeling of the existing ground with SUASs will allow projects in all phases to have this ability.

Keywords: Small Unmanned Aircraft System's, Orthomosaic maps, Photogrammetry, Thermal maps, Lidar mapping, Multispectral maps, Topographical maps.

Background of SUAS Surveying

SUAS surveying is the process of collecting data points and elevations of the Earth's surface for mapping; whether it is for construction projects, general control surveys, and other survey uses. SUAS is an unmanned aircraft that can be a fixed-wing aircraft or a multirotor aircraft ranging from one to many rotors that would be on the SUAS's airframe. “Comparing to conventional helicopters, quadrotor systems are more stable in flight with reduced vibration and have the mechanical advantage of not requiring a large, variable pitch rotor-unit”(Admin, 2015). In general, the fixed-wing SUAS tend to have longer flight times because of lift via the wings; but, tend to lack the ability to hover and carry payload. Fixed-wing SUAS tends to be a better option for more extensive lower precision surveys due to the incapability to hover to get the multiply angles of photos that a quadrotor or Multirotor can achieve. Multirotor SUAS tends to be more precise while surveying because of the ability to hover. This precision comes at the cost of flight time since hovering tends to take more energy than moving the multirotor SUAS. Hovering allows for multiple angles of a surface so the images and data points can be combined to create a more accurate and precise representation on the surface, which might be nice at the end of a project for an as-built survey as a high-quality photogrammetric model. A “total station is a combination of electromagnetic distance measuring instrument and electronic theodolite”(Yun-Yao Chi, Ya-Fen Lee, and Shang-En Tsai). The total station can measure horizontal and vertical angles as well as the sloping distance of an object to the instrument”(Gupta).

Introduction

There are many uses for the Small Unmanned Aircraft System (SUAS), more commonly known as drones. Services of SUAS' ranges from hobbies to the commercial market because of the versatility and different airframes with relatively low cost to its manned counterpart, the airplane, and a helicopter. A significant use for SUAS is surveying because it provides a different view of the land and faster collection of data points and images than total stations. This research paper will be looking at how SUAS's are in use in the surveying field, and photogrammetry surveys for drones combined with software. How and why is the use of SUAS important to surveying? SUAS's service allows for innovation in the survey field with a very long history. It will provide quicker mapping and collection of data points globally, mainly with SUAS's airframe and photogrammetry.

Three-Dimensional Modeling

SUAS can be used to create three-dimensional model buildings and other surfaces. This is even true for the hobbyist, with apps like DroneDeploy and Pix4Dcapture. DroneDeploy and Pix4Dacpture apps allow SUAS to take many photos with the SUAS in the air with a pre-planned route via smartphone in the DroneDeploy, Pix4Dcapture app. "DroneDeploy is a San Francisco based company founded in 2013 that produces grammatic photo software and other modeling features. That allows uses of 3rd party software like Autodesk to be used with DroneDelpoy" (A Beginner's Guide To Drone Mapping Software 2020). "Pix4Dcapture is a Swiss company that allows many different types of photogrammetric capabilities and mapping features" (A Beginner's Guide To Drone Mapping Software 2020). Both of these companies have many similar features like some cloud bases processing.

When the SUAS is in its flight with these apps, it follows the path or flight plan created to take photos of locations and surfaces. Once the flight or multiple flights are completed with the collection of pictures of the desired surface, the next step is to upload the secure digital or SD card for short, to the computer, and process the photos at DroneDeploy's or Pix4Dcapture's website. They are uploaded and stitched into a realistic three-dimensional model. This is creating a three-dimensional model of the Earth's Surface or structure. This use can significantly fit into many industrial fields because of its wide array of services and not just in the surveying industry. Surveying is intertwining in many other areas, like civil engineering. However, this technology can be instrumental in constructing surveys where the company needs a basic model of what they have built so far. Hence, they know where to go next or can then make a finished product model for marketing. Of course, these two software programs and many others are not just capable of three-dimensional modeling.

Mapping

"Much of current land, engineering, and survey work via global position system (GPS) and the total station are often labor-intensive, and the completeness of the data captured often depends on the time and cost allotted to the survey project" (Yun-Yao Chi, Ya-Fen Lee, and Shang-En Tsai). Mapping land is another use for SUAS and can apply with the same software, allowing many photos taken by a SUAS of the Earth's surface with data points. In addition, construction sites or map-making for small and large areas possible. When map-making, the addition of lines to a construction site map can help with the project's overall flow. This process is done with a software called ArcGIS. It is one of the many software that allows taking high- resolution SUAS photos and data

points to be manipulated and edited to create a mapped model of the said construction site. ArcGIS is one of many different programs in play after collecting surveying points or points with a SUAS. This software streamlines the mapping process and allows for faster map-making for the public such as a residential park or a street layout project.

Topographical mapping

DroneDeploy software allows surveyors to use their photos to make topographical maps from the images taken for a site. A topographical map is a map that has contour lines to show elevation collected by surveying the land of an area. The simple fact that SUAS and the software combination allows getting elevations of the Earth's surface and can produce a topographical map shows the power of this technology. This technology is just getting started in the market; who knows where this will end up years down the line. Mapping a landfill is one area that a drone application is useful. Topographical maps that SUAS help create and help estimate how much landfill has been filled in the past year. Since this requires little involvement of high-accuracy topographic mapping tasks, the SUAS can fly over and collect data points over a landfill by taking photos and creating a topographical map. This way is safer for a surveyor than having to survey around garbage with a total-station. The total-station would be a longer process as well, and there would be fewer points collected because of the elevation and the landfill's openness. A drone can fly over the areas and not worry about elevations and the landfill being open. In turn, the SUAS can collect more points, but they are not as accurate as the total station. This combination is a great application for SUAS and topographical maps.

Accuracy

SUAS, unfortunately, is not more accurate than total stations. SUAS has some minor issues, as well as, the camera is in a different spot than the GPS, so there has to be an error correction for the data. Frequently, the SUAS starts surveying from a control point taken by a total station. SUAS can only be accurate as of the total-station error from the start of the survey, and errors tend to go up there. There is a promise that they can work together, especially in the upcoming years with SUAS. With researchers testing how accurate SUAS is compared to total-stations without a tied control point. “The accuracy of UAV-based topographic is less than 0.0005 (1/2000), similar to the accuracy of the closure ratio of the ground survey. This accuracy means good UAV-based topographic quality. The result shows that UAV-based photogrammetry would be accurate. Enough to map high accuracy topographic. The UAV-based surveying may be to replace current GPS and total station in the future”(Yun-Yao Chi, Ya-Fen Lee, and Shang-En Tsai).

In conclusion, SUAS surveying has many benefits for surveyors. The help of software and SUAS allows for three-dimensional modeling along with many types of mapping. These maps can be created faster and with more points than in less time for surveys, even though SUAS is less accurate than total stations. The speed and the number of points are what sets this technology apart. Keep in mind this technology is relatively new for this application. “This technology is just getting into the market; who knows where this will end up years down the line.” There is a lot of growth to be had in this industry. Look at how fast drones came into the market and how much they have done once they became commercially available.

Bibliography

Admin. (2015, October 27). A resource on positioning, navigation and beyond. Retrieved October 03, 2020, from https://mycoordinates.org/determination-of-surface-characteristics- and-alteration-of-koru-mining-area-by-uav-photogrammetry/

Drone Pilot Ground School. (2020, May 28). *A Beginner's Guide to Drone Mapping Software*. Drone Pilot Ground School. https://www.dronepilotgroundschool.com/drone-mapping-software/.

Gupta, V. (n.d.). Introduction about the Total Station. Retrieved October 03, 2020, from https://www.selfgrowth.com/articles/introduction-about-the-total-station

Yun-Yao Chi, Ya-Fen Lee, and Shang-En Tsai. (, 2016). *Study on High Accuracy Topographic Mapping via UAV-based Images*. ShieldSquare Captcha. https://iopscience.iop.org/article/10.1088/1755-1315/44/3/032006/pdf.