

Drone Photogrammetry Software for Highest Performance

Introduction

Over the past few years, drones have grown exponentially in terms of popularity, which also means that there is a wide array of software that has been created for them. There is an abundance of ideas that are inclusive in the use of drones, and many of these ideas vary in different qualities, but there is also a multitude of aspects of the software on drones that are similar as well. The specific software that one decides to implement for their drone is heavily dependent on the project that is at hand. The potential opportunity for quadcopters continues to grow every year. For my group's senior design project, we are looking forward to being able to build an autonomous quadcopter, meaning it will be able to map an area and arrive at the desired end state autonomously. For my technical review, I will be evaluating the different mapping software that has been used for alternate projects to collect qualities that would be ideal for our drone.

Commercial Applications of Drone Mapping Software within Industries

A significant function of a drone is its ability to map an area. Only a short time ago, the only way that an aerial photogrammetric map with high accuracy is using an aircraft that was piloted with a human inside. Fortunately, now that drones are advancing and becoming more cost-friendly, they are up for the task as well, and many people and industries are taking advantage of the fact.

Construction

Within the construction industry, they can make use of drone mapping to give clients updates on the projects that they are investing in by providing a three-dimensional model of the construction site. That way the clients can see their projects, and make any decisions on necessary changes if necessary. Furthermore, in the construction industry and other similar cases, mapping an area become handy for detecting irregularities, such as holes in the roof or leaks. [1] The use of an autonomous drone in these cases, could be of high use in this industry, where the drones can do advanced jobs that can improve the efficiency and expedite the workflow for those who this process is relevant to. Common software used in the construction industry comes from DroneDeploy, which is user-friendly and has beginner and advanced features. They're able to perform several types of in-field data analysis and three-dimensional maps can be created in differing formats which is a great feature for their clients. The company's enterprise platform contains an aggregate of features, it is easy to manage for those who have many team

members or clients who need your data and maps on their own mobile devices while they are out in the field. [2] The software retails at an affordable price of \$399 per month. [3]

Mining

Another industry where the mapping of drones is being used commercially is within the mining industry, where they are embracing the use of mines to manage a variety of things, such as stockpiles, water draining, erosion detection, and dump management. Because of these capabilities from drones, the managers can be highly aware of their mining areas and have stronger control over potential situations, further keeping employees within the mines safer as a direct consequence. A real-life case study illustrating the convenience of drones in the mining industry can be drawn from the case study where workers from a mining company in Canada were able to evaluate the lifespan of mining waste to developing a plan for expanding the sites where they stored waste. [1] Propeller is another popular mapping software which is built for mining, construction, waste management, and consulting industries. The companies offer many mapping features for sites such as site management and tracking any changes to ensure safety. [2] For enterprise use, this product retails for \$599 per month. [4]

Technological Uses

Technology Implementation

Although mapping software has complex capabilities, the building blocks required to implement this technology is minimal. There are many implementations of photogrammetry mapping technologies currently on the market, and they all have similar functionalities and algorithms, which have evolved. Today, many mapping drones work in similar ways. First, there is a drone which attains a platform that can carry an imaging sensor through a flight path. There is a camera that captures overlapping pictures while the drone is in motion. [5]

Underlying Technology and Algorithms

The algorithm for the software within the drone take those pictures that were captured and makes use of popular algorithms within computer vision and photogrammetry. A very popular algorithm within photogrammetry is the Levenberg-Marquardt algorithm which can minimize the sum of squares of errors over the coordinates and relative displacement of the reference points, which are especially useful for orthoimages, where the photos of a map are geometrically corrected so that the scale is uniform. These same algorithms extract geometrical shapes through matches of thousands of key-points for generating accurate maps and three-dimensional models. The images go through sparse and dense reconstruction to create a 3-D model. The technology allows for the creation of digital surface model images which is a

representation of the area with the use of elevation, similar to a heat map. Each pixel is assigned a color to represent the height of that point in the image. [6]

Improvements

Although modern drone hardware can withstand harsher weather conditions as time goes on, the software is still hindered by small obstructions, such as it being too cloudy outside. It would be a significant improvement for the drones to be able to still map even in low lighting. This may be able to be done with the use of popular image processing techniques, such as Gaussian filtering in order to enhance the contrast of darker images. [7]

Another issue lies in the ability to use real-time mapping capabilities from drones in environments where GPS access is denied. Using two cameras working together with a laser scanner to gain the depth of image features and the iterative closest point algorithm, an enhanced system can be implemented. [8]

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