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3D-Range Finder and LIDAR Devices

Range finders have been utilized as far back in time as 1880, although the common range finder of our age is the laser range finder. The 3D range finder has a primary function of mapping lines and surfaces from an input streams primarily using algorithms such as Hough-Transform and matching algorithms. This iteration of the range finder comprises of many processes which have evolved rapidly since the inventions birth. Initial design of range finders in the late 19th century consisted of an arrangement of lenses and prisms set at each end of a tube with a single eyepiece at its center. Additionally, these early range finders, known as coincidence range finders, determine the desired object's range by measuring the angles formed by a line of sight at each end of the tube. The modern range finder, which I will outline ahead, features a laser component. This technological advancement was discovered in 1965 and is utilized in range finders even today. Known most commonly for use in the sport of golf, range finders are also used in hunting, 3D modeling, forestry, and the military. The general result of a laser range finder is calculated by surface detection and object segmentation algorithms. Surface detection involves the following steps: 1) An initial set of lines is stored via a 2D scan. 2) Every other line is checked and if a matching line is found, the two lines are transformed to a surface and saved to memory. 3). If a line has no match, and it is not identified as an extension of another line, the line is stored as a single line in memory. All range finders share the classification of an exteroceptive sensor – the range finder measures an outside range separate from device. They also share the characteristic of being 'passive' as they observe the surroundings. The advantages of 3D range finders over other types includes increased accuracy of data points and the ability to create a 3D model including object depth. Thus, the advantages of this technology are significant for range finders seeking maximum accuracy or perusing further research into 3D modeling. However, alike to many facets of life, 3D range finders contain negative aspects as well – it involves more moving parts, increasing the chances of maintenance needed, it is more expensive due to the addition of cameras and other necessary hardware, and it requires complex algorithms to be written and tested which can take up crucial time. To me, the most fascinating aspects of 3D range finders are that the range finder has improved on itself over a long period of time and each iteration can be researched, and that range finders in this day and age combine threads of input streams mapped and sorted into points, lines, surfaces and objects to project a virtual 3D environment to allow for maximum accuracy for range projection and allowing for robots to better 'sense' the outside world.

Figure 12: Detected surfaces and objects in fig. 11

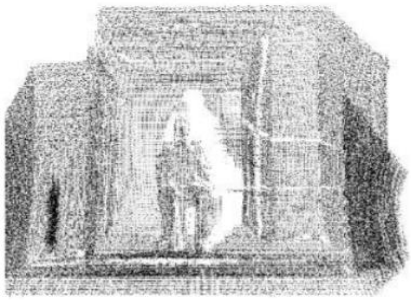


Figure 9: Scanned points

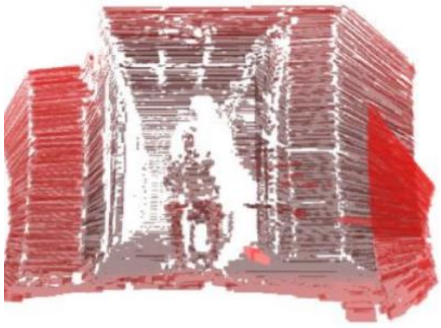
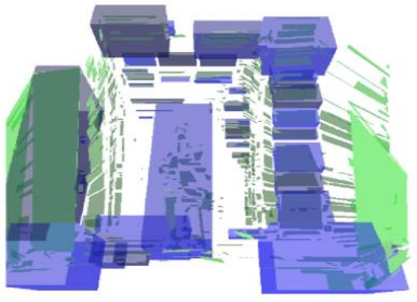


Figure 10: Detected lines in fig. 9

Figure 11: Detected surfaces in fig. 10



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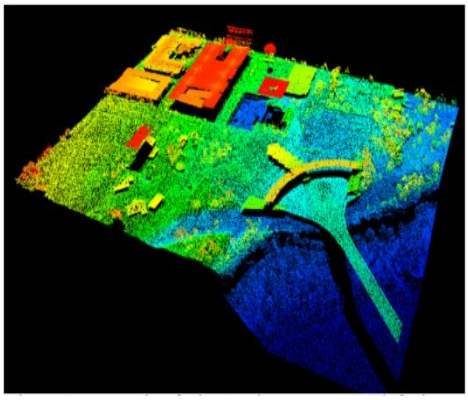

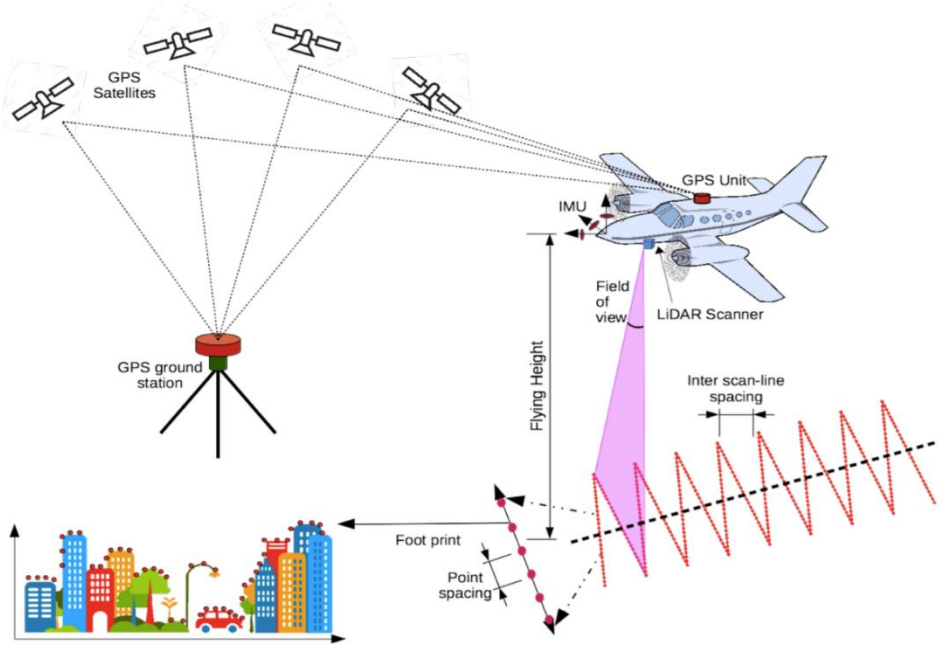

LIDAR is a popular method of laser beam sensor such as the aforementioned laser range finders. Laser technology was invented in the 1960s, and it took several decades before the LIDAR, or Light Detection and Ranging technique, was created in 1990. LIDAR is a laser 3D modeling technique for many specific purpose - establish atmospheric constituents, solid objects, the distance of objects, and the depth of objects. In addition to these qualities, LIDAR typically utilizes a three hundred and sixty degree view. This, among other advantages over laser beam methods such as increased accuracy and responsiveness, have attracted considerable attention from professionals worldwide. However, LIDAR technology has two large disadvantages – it does not work properly unless in ideal weather conditions, and it is quite an expensive process. Regardless, interest had led to developing technologies that utilize LIDAR, the most common being LASIK eye surgery. Other uses of LIDAR include archaeology, atmospheric physics, forestry, geodesy, geography, geology, geomatics, geomorphology, laser guidance, seismology, and surveying.

LIDAR technology can also be classified as an exteroceptive sensor as it measures an outside range separate from device. It also contains the characteristic of ‘Passive’ as they only observe their surroundings. The above figures act as a visual interpretation of how LIDAR works and the output data it receives. On the left shows the point cloud, a mapping of all distinguishable points, of the input stream colored as per height. Thus, we can see the red object is the highest in the room with our LIDAR sensor output. Moving over to the right is a figure outlining an example use case of LIDAR – a surveillance drone LIDAR utilizes its field of view along with algorithms such as those discussed in 3D range finders as well as others to account for Inter scan-time spacing. IN this example, the LIDAR data is broadcasted to GPS satellites and then to a ground station where it can be processed. In short, LIDAR is a type of laser beam sensors and a 3D range finder is an implementation of laser beam sensor technology.

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