

► FEATURE ► WILLIE CARROLL, C.E.T., LOCATION INTELLIGENCE & DESIGN

Soaring



Providing Unique Insight into Turf Management

Above



Figure 2 A drone that can be used to collect thousands of photos to create NDVI images.

With the fast-changing world of technology, drone use within industries has seen a dramatic rise over the last few years. From using drones to monitor fuel leaks in forest fires to collecting the spray from wheat plantations, the capabilities of drones are endless.

One area that is up and coming is the use of drones to assist with golf course maintenance, such as monitoring turf and vegetation health, early disease or fungus detection, or identification of underlying drainage issues.

Using the advanced the Normalized Difference Vegetation Index (NDVI) turf health can be assessed to identify issues or areas of concern that need to be field checked or monitored. Early

detection of possible fungal invasion on greens can be identified so that a treatment can be started before the invasion becomes visible.

Most modern golf courses have internal tile drainage under the fairways and greens. Blocked or partially blocked tiles can be detected using NDVI maps by identifying areas of low turf health.

DEFINITION OF NDVI

NDVI was developed by NASA in 1974 as a way to measure the health of vegetation from satellites on a large scale across the planet. The process of NDVI is still used today for capturing imagery in visible and near-visible light wavelengths and has become the standardized method of vegetation health assessment. The most popular use case of NDVI is in agriculture to detect crop health.

WHAT IS NDVI?

Traditionally, NDVI imagery is captured by satellites for large-scale operations. Modern day imagery is now being captured by aircraft and drones that allow for higher quality data for smaller scale operations. NDVI maps are created from the reflectance difference

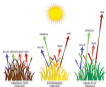


Figure 2: Turf reflectance with simulated amounts of wavelengths emitted.



Figure 3: An NDVI map of a series of holes showing turf health. Areas in solid red are bunkers and cart paths.

between visible Red Light and near-visible Near Infrared (NIR) Light.

Red Light is absorbed by plants for use with photosynthesis while NIR Light is reflected. Green Light is also reflected and is about 3-80 times less intense than NIR Light resulting in the plant's green appearance to the human eye (See Figure 2). When a plant becomes dehydrated, sick or affected with a disease, the spongy layer of the leaf or blade where the chloroplast is stored, deteriorates and the plant absorbs more NIR Light.

An equation involving the quantity of NIR Light and Red Light is used to calculate NDVI values to create an image where the values change depending on

the health of the plant; higher values indicate a healthy plant and lower values indicate an unhealthy plant.

HOW THE DATA IS COLLECTED

A drone can fly over a golf course to capture the imagery required to produce an NDVI image. A drone is equipped with two sensors, a standard camera capturing the Red, Blue and Green Light wavelengths, and a specialized sensor that measures the NIR Light reflected from the turf below the drone (See Figure 2).

As the drone flies over the entire course, many photos are taken which are then "stitched" together to make one large image. This image is then analyzed to determine areas within the turf with low health or other areas of concern.

WHY COLLECT DRONE DATA?

Due to their size, drones can be transported quickly and relatively easily. Other methods take longer using an aircraft, requires more planning and logistic, and satellites have a set return rate, when they orbit over the exact same spot on the Earth, which is usually an average of 20 days. Data can be collected faster and at more frequent intervals by using a drone. This results in updated information throughout the season, which the grounds crew can use to manage turf health.

THE USE AND BENEFITS OF NDVI

On an NDVI map, green areas or high NDVI values represent healthy plants that require less maintenance. Areas in red or low NDVI values represent unhealthy plants that would benefit from more care by the grounds crew to improve the quality of the turf (See Figure 2). This will allow for grounds crews to work more efficiently where more maintenance is required, so that they don't spend time on areas that may not need it.

The data is fully GPS-calibrated so maps can be overlaid to tablet devices and carried into the field to consistently show your location in respect to turf management issues that have been identified by the use of NDVI. This allows for maintenance teams to conduct spot checks to ensure that the right areas are being targeted.

By identifying vegetation health and stresses before they are seen by the naked eye a drone can help target areas needing more attention throughout the golf season. Using drone technology for golf course maintenance does not make maintenance staff redundant, rather it is an extra tool to make their efforts more efficient and cost effective. **DM**