



LiDAR

LIGHT DETECTION AND RANGING

WHAT IS LiDAR?



How does LiDAR create competitive advantage for its users?

How does FlyGuys elevate what LiDAR can achieve?

WHAT IS LiDAR?

How does LiDAR work?

For too long, technological gaps and logistical hurdles have impeded high-quality data collection. No longer: today's cutting-edge scanning and data gathering technologies are putting the world at the fingertips of surveyors, investigators, and project owners.

For example, when researchers recently discovered a network of ancient villages abandoned centuries ago in the Amazon, it wasn't because they painstakingly (and expensively) hacked their way through endless jungle. They simply flew overhead and deployed one of the most advanced scanning technologies available to surveyors today: LiDAR.¹

Short for Light Detection and Ranging, LiDAR is a technology that uses lasers to produce higher resolution, more detailed, and more accurate scans than almost any alternative. With it, users can create incredibly precise topographies and build highly accurate 3D models. They can provide classifications that differentiate man-made structures, low/high vegetation, buildings, roads, power lines, and more. LiDAR works by scanning from different angles, measuring the intensity and timing of the reflected laser beams, and combining those recordings with GPS and Inertial Measurement Unit (IMU) data. As a result, LiDAR scans can produce a digital representation of terrain, structures, and other objects composed of millions upon millions of data points in a format used by professional surveyors. Those "point clouds" can be processed in myriad ways to meet the needs of users, yielding outputs that would otherwise be impossible to produce.

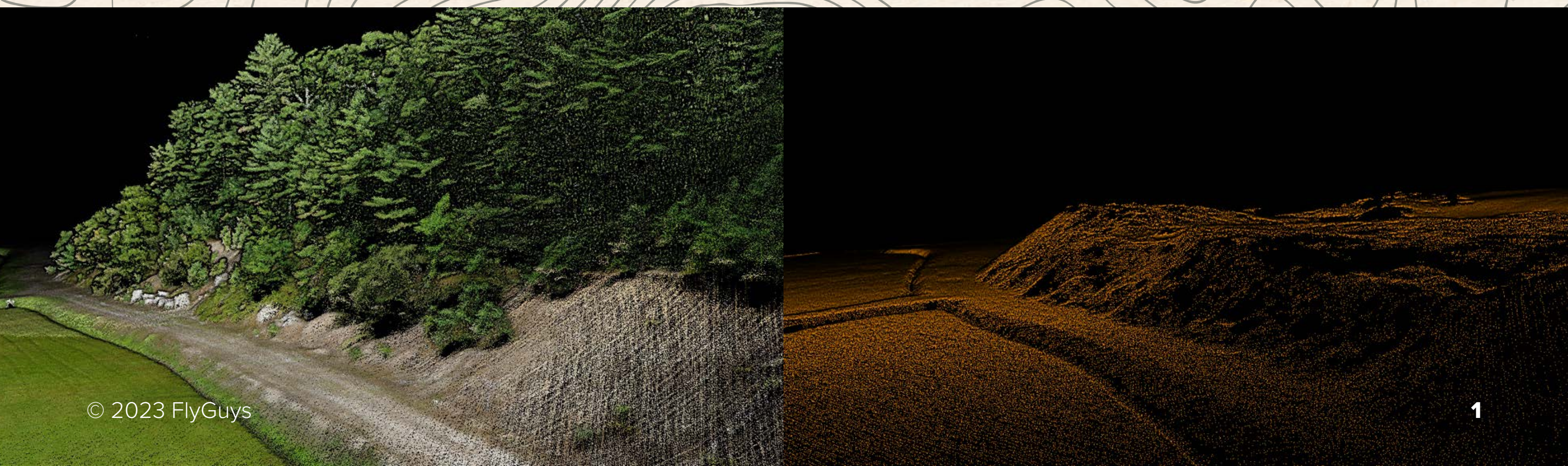
What makes LiDAR different?

LiDAR differentiates itself in its ability to produce incredibly detailed, accurate, and data-rich representations of scanned areas. For one thing, LiDAR can penetrate foliage, vegetation, and other obstructions to detect the bare earth terrain underneath. So, site planners mapping in a construction project can use LiDAR to see what's *underneath* vegetation in the area. That can help them answer important questions, like how much dirt or other materials they may need to bring in or remove (or whether there are any long-abandoned villages lying half-buried beneath a thick canopy).

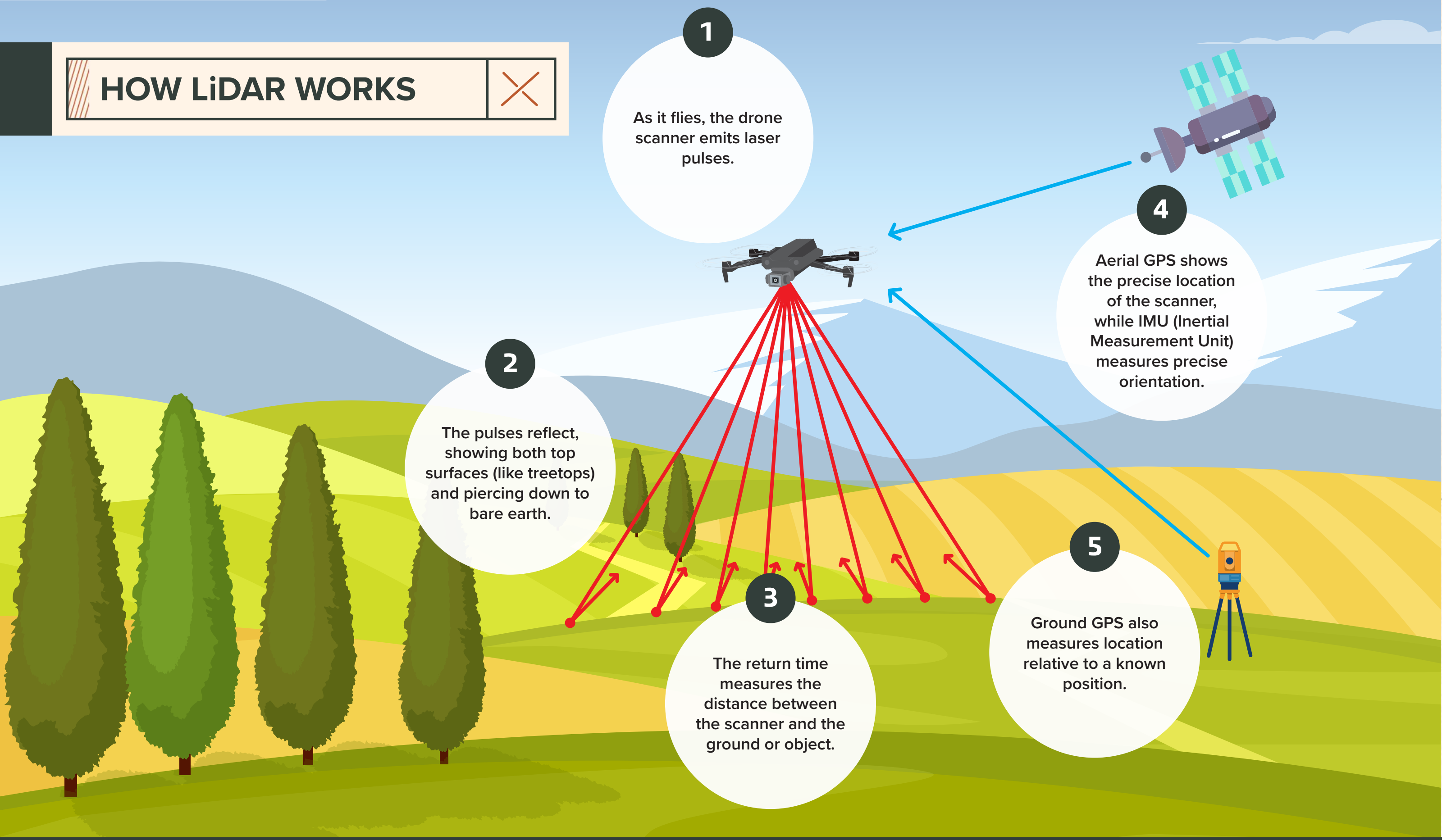
LiDAR can also capture otherwise hard-to-see structures and objects. Photogrammetry, for instance, can struggle to spot and produce information about thin or small features like power lines, pipes, branches, edges, etc. LiDAR maps them instantly and can even capture data in low-visibility conditions like darkness. It can "see" where other visual technologies would be rendered blind.

LiDAR does face its own limitations. For one thing, it cannot penetrate water or work effectively around snow and ice. It's limited to line-of-sight scans; its ability to see through vegetation is due to its ability to penetrate gaps in the canopy. As a result, it doesn't necessarily replace other scanning methods like photogrammetry or traditional aerial or groundbased photographs in all circumstances. However, LiDAR's unique capabilities, extreme detail, and longterm cost-effectiveness make it the modern option of choice for most surveying or scanning projects.

LiDAR Tree Extraction (Seeing Through Foliage), Before and After



HOW LiDAR WORKS



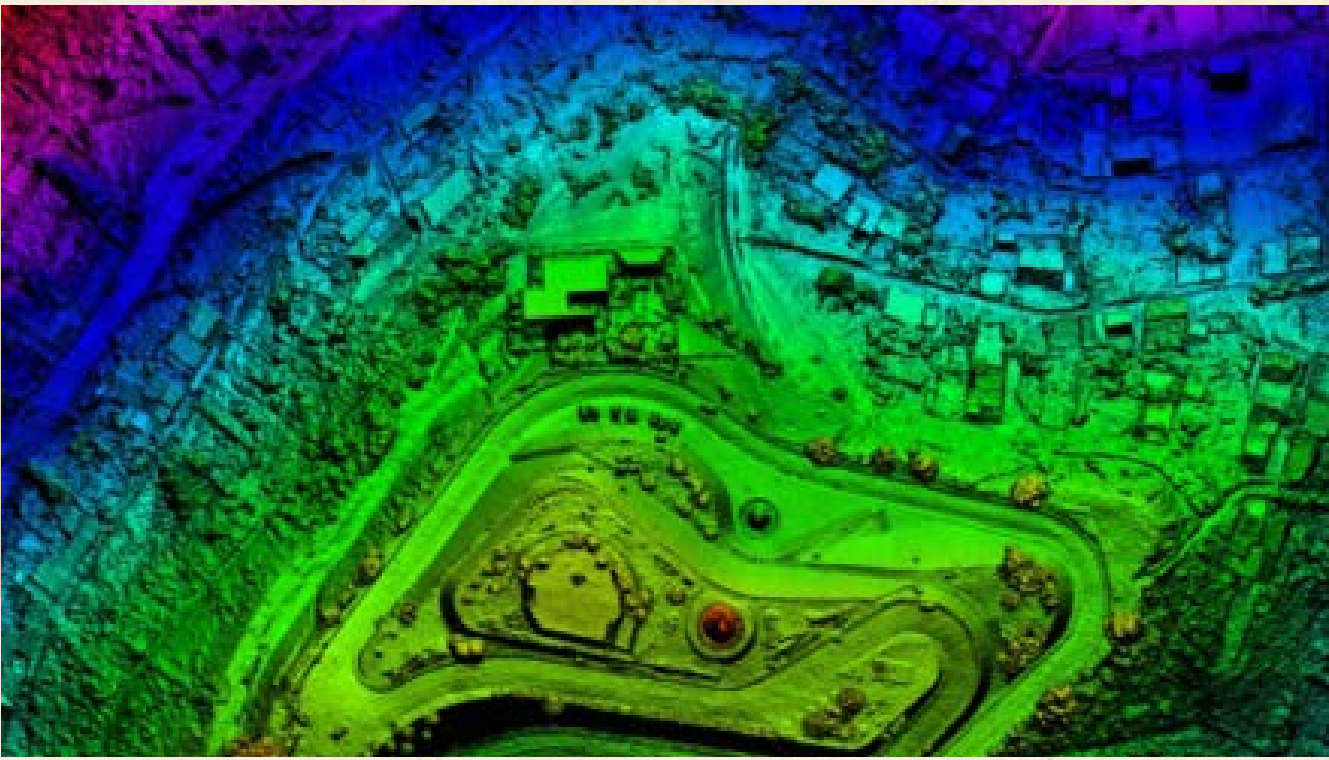
A LiDAR PILOT'S PERSPECTIVE: Zachary Lilleyⁱⁱ

“LiDAR systems emit laser pulses that bounce off objects and return to the sensor, allowing it to measure the distance, shape, and other characteristics of objects. A typical LiDAR job begins by finding an open space to set up a base station to log GPS data.

“Once the base station is established, I set up the targets to align horizontally. It’s important to consider the specific features that have to be captured accurately and to scan from multiple angles to ensure a comprehensive 3D model can be created.

“Then the entire site is flown, usually just under 200 feet. Once the site is scanned, the rover checks the targets for accuracy and verifies the LiDAR data after scanning and a base file is created for further processing.”

LiDAR COMPARED TO OTHER SCANNING METHODS



Vs. Photogrammetry Data Collection

Photogrammetry is an approach to imaging an object or area that works especially well to capture RGB footage and generate an orthomosaic, which is like a high-res Google earth image. This method is best suited to bare earth situations or large sites that aren't obstructed.

Photogrammetry can produce beautiful topographical surveys and elevation maps with color-coded heights but is limited by line-of-sight and cannot see through obstructions like vegetation.

Vs. Traditional On-The-Ground Approaches

Photos generated via physical, manual shooting can still be a simple, low-tech way to produce basic information – like a quick visual indicator of project status. However, it's simply impossible with only basic, traditional imagery to produce the number of points or kinds of data LiDAR generates.

Traditional photos and other survey methods can still produce useful information, like verifying the status of a construction project, but cannot produce data-rich scans or maps.

LiDAR, ACCURACY, AND NEW POSSIBILITIES

Importantly, the choice of scanning method isn't an either/or. LiDAR clearly offers a lot of advantages to recommend it, but LiDAR can often work effectively in concert with other methods like photogrammetry or traditional surveys.

Photogrammetry can give you a high-resolution, colorized view of “the big picture,” while LiDAR can offer even more granular information like volumes or accurately determining how far away an object is and/or, potentially, what's beneath it. With both inputs, users can create orthomosaic scans separately and tie them into the same ground control in order to improve accuracy and visual helpfulness beyond what either method could achieve alone.

LiDAR produces such accurate measurements thanks to the incorporation of aerial and ground-based GPS and IMU data. By overlaying the LiDAR data on top of

those other location-based datasets, users can produce incredibly precise representations of structures and topography.

The accuracy gains have even been quantified by researchers. In one study, drone data collection in ecology was found to be as much as 96% more accurate – roughly twice as accurate, in other words – than traditional ground-based collection methods.ⁱⁱⁱ LiDAR in particular was found to provide point density between 50 and 200 points/m² even from elevations as high as 2000 m (6600 ft), yielding measurements that are both more detailed and more exact.

Outside of surveying, this level of accuracy is why LiDAR has become such an integral part of modern innovations like self-driving cars^{iv} and even space exploration at agencies like NASA.^v

BENEFITS OF LiDAR BY USE-CASE

In almost any sector or application, LiDAR surveys can open up new possibilities in data collection that would be otherwise impossible, while simultaneously improving on current capabilities.



ACCIDENTS	AGRICULTURE	ARCHEOLOGY	CONSERVATION	INSPECTIONS	INSURANCE	FORESTRY	LAW	MINING
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See the Unseen									
Find hard-to-spot details	✓		✓	✓	✓	✓		✓	✓
See through vegetation		✓	✓	✓	✓	✓			✓
Reveal hidden, overgrown, and/or buried details not visible to the naked eye	✓		✓		✓	✓	✓	✓	✓
Capture detail in low-light and other low-visibility conditions	✓		✓	✓	✓		✓	✓	✓
Create Data-Dense Maps									
Survey, map, and model terrain without damaging or disturbing the environment	✓	✓	✓	✓	✓	✓	✓	✓	✓
Create highly accurate maps and survey models with millimeter precision		✓		✓	✓			✓	✓
Populate maps with relevant, useful, actionable information		✓		✓			✓		✓
Better identify and understand the hazards, obstacles, and safety risks in a geographic area	✓				✓	✓			✓
Quickly, Easily Assess Areas and Situations									
Scene reconstruction	✓		✓	✓	✓	✓		✓	
Assess flooding (it can't detect or see through water but can precisely measure non-flooded areas)		✓		✓	✓	✓		✓	
Generate credible evidence of events	✓				✓	✓		✓	
Gain tactical information about an imminent, immediate, or recent event to better assess and triage the situation	✓							✓	
Accurately Track Movement and Change									
Track transient property or objects (e.g., livestock, vehicles, or even lost people)	✓	✓		✓	✓	✓		✓	
Generate a historic record that can be tracked over time by comparing previous scans with new ones, e.g., Track landscape erosion/movement over time, the drying up of lakes and rivers, the changing volume or distribution of trees, etc.		✓		✓	✓	✓	✓		✓
Work Remotely or at a Distance									
Avoid needing to work at heights (e.g., ascend towers, climb onto roofs)					✓	✓	✓		
Identify potential resource sites (e.g., ore deposits) quickly without having to send teams to remote sites		✓		✓			✓		✓

HOW LIDAR DRIVES COMPETITIVE ADVANTAGE

FOR YOU AND YOUR CLIENTS

LiDAR can deliver tremendous value for its users – enough to create brand-new competitive advantages. Whether you are the end-user of the LiDAR scans and maps (like a property owner) or a surveyor or other third-party vendor who supplies or works with such scans, LiDAR can drive advantages that translate into bottom-line business benefits. That can include potentially dramatic time and cost savings, as well as opportunities for enhanced revenue generation. In other words, from a business perspective, LiDAR isn't just about producing better scans. It's also a tool that can be used to strengthen your company, better meet organizational objectives, and improve business outcomes overall.

[01] With LiDAR, you can get the job done faster than competitors.

In the survey engineering world, time spent in the field – and its associated costs – is the top concern of business and project owners. Thankfully, LiDAR utilizing projects can outcompete others in this area. What takes traditional methods weeks or months, takes drone-based LiDAR a day. This can reduce both project timelines and labor strain, given how manual and strenuous – and occasionally hazardous – traditional survey methods can be.

Part of the difference isn't just LiDAR technology *per se*; it's the combination of using LiDAR with drones or unmanned aerial vehicles. For example, one study found that drones reduced inspection

times by as much as 98% (in one case reducing an estimated 293 hours required for ground-based manual inspection down to a mere 6 hours to inspect via drone, saving \$25,485 in costs in the process).

That said, LiDAR is a key element of regaining time efficiencies in certain applications. For example, conducting a large-scale inspection documented mostly with manual photographs is incredibly labor-intensive and could *still* fail to produce the kind, quantity, or quality of data needed to render best results. LiDAR makes the impossible achievable in these cases.

Weeks of Time Savings Surveying 8 Solar Farm Sites in Virginia

Aerial LiDAR working in tandem with surveyor to produce survey-grade topographical map. The sheer size and detailed specifications of the project would normally mandate a costly, time-consuming data collection process. Use of LiDAR shaved two weeks of estimated project time and yielded a \$20,000 cost reduction *per site* (mostly in labor savings). That's because the LiDAR solution required only 1-2 days per site with only one operator, rather than a full field crew.

Project Size	Time Saved Vs. Traditional Survey	Net Cost Savings
8 Solar Sites	2 Weeks	Est. \$80,000

02

LiDAR can produce otherwise impossible deliverables.



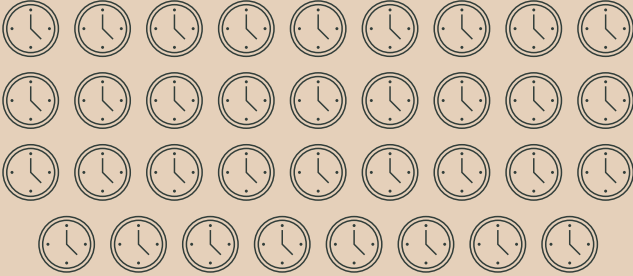





Time savings can translate into newfound possibilities. For example, some environments *can't* be surveyed or inspected in the absence of LiDAR. LiDAR can detect thin, hard-to-spot objects like power lines – and then can capture them regardless of environment conditions or obstructions like highly vegetated surfaces.

For instance, surveyors conducting an aerial review of a highly vegetated area were able to identify and map 200-year-old walls only by seeing through the thick canopy of trees covering the landscape with LiDAR scans.^{vi}

Similarly, LiDAR can also enable projects that wouldn't otherwise be possible due to safety concerns. For instance, if a company needs to turn in an annual report on asset integrity by a certain deadline after a disaster like a hurricane, but can't reach the site safely on foot, drone-mounted LiDAR scans can make the project possible regardless of vegetation or visibility. Even better, completing these projects does not come at added cost. The time and labor efficiencies of LiDAR ensure that even these otherwise impossible surveys and inspections can be conducted *and still* produce cost savings and positive return on investment.

250-Acre Forest

One property owner wanted to collect vegetation data, as well as find still-standing 200-year-old walls, across 250 acres of forested land. Normally, such a survey would have taken weeks and a full crew. With LiDAR-equipped unmanned aerial vehicles, the process required only 2 days, generated over 211 million total points (including under heavy vegetation), and likely saved \$35,000 to \$45,000.

	MANUAL INSPECTION	DRONES
WORKERS REQUIRED	4-person crew 	Only 1 operator required 
TIME TO COMPLETE	3 to 5 weeks total 	2 days on site 
NUMBER OF VISITS	Multiple visits 	One visit 
TOTAL COST	Conservative Estimate \$41,600 	Actual Cost \$7,000 
		Est. \$34,600 in total cost savings

03 You can come in lower on proposals to outbid competitors – and/or add to your own margin.

LiDAR users can leverage project time and cost savings in multiple ways. For one, they can pass some or all of the savings onto clients, undercutting competitor cost proposals. For another, they could still bill the same amount as for groundwork, increasing their own margins or revenue. The potential dollar amounts at play can be significant. A study commissioned by the Florida Department of Environmental Protection assessed LiDAR's use in bare-earth ground elevation surveys, inland bathymetry, and nearshore bathymetry. They projected more than \$28 million in annual net benefits, with a benefit-to-cost ratio as high as 5.1-to-1.^{vii}

These kinds of savings create opportunities to undercut competitors who are still relying on older methods of data collection or to increase revenue margin. It's important to note that LiDAR itself plays a pivotal role. Photogrammetry, for example, can also reap the benefits of drone usage – speed, ease, accuracy – but will not be able to pierce a forest canopy or spot wires or other small/thin infrastructure at a solar site. In cases like those, without LiDAR, manual data gathering will still be required, and the cost savings will not materialize.

04 LiDAR can verify subcontractor claims or work.

LiDAR can also help to minimize or eliminate certain forms of risk for business owners. Case in point: subcontractors or vendors whose actual work is otherwise difficult to verify and could lead to payment for work that's not completed in full, at all, or up to specification. Consider a construction company undertaking dirt work; the contractor in that situation may turn to a subcontractor to provide them accurate measurements of how much dirt is going into or coming out of the site. The contractor could use LiDAR to provide third-party validation to compare their subcontractor's volume claims against measurements provided by highly accurate volumetric LiDAR analysis. In some cases, catching subcontractor errors (or lies) could save tens or even hundreds of thousands of dollars.

Similarly, surveyors could use LiDAR to verify previously completed surveys. In this case, use of LiDAR isn't necessarily catching a subcontractor in a lie or error. Instead, it's verifying that existing records are still accurate and up to date through a fast and relatively inexpensive survey.

05 You can ensure no interruption to client operations.

LiDAR can also offer a methodology for data collection that permits clients to continue operating with no shutdowns or disruptions required. Traditional data collection methods typically require multi-person teams (usually at least 2) to walk around the area, set up equipment, likely interrupt operations, and maybe even create safety hazards. Some facilities can lose thousands or more dollars per minute while operations are shut down. The average auto manufacturer loses \$22,000 per minute due to downtime.^{viii} The energy sector can see double that in losses.^{ix}

With LiDAR equipped drones, operators can fly overhead, gather data from 100 to 150 feet away, and avoid interrupting day to day operations altogether. For example, flare stacks in a petrochemical refinery don't need to be shut down for an inspection or review. That also means the operation doesn't have to go through a cooling period until the area is safe for humans to traverse.

HOW FLYGUYS SKYROCKETS LiDAR'S ADVANTAGES

The technology alone is only part of the picture. How the services are rendered – and by whom – makes a *big* difference in determining whether the ultimate project outcome soars or crashes. That's because a LiDAR program that's handled inefficiently or poorly will erase or constrain all of the potential gains from using it in the first place. Here, FlyGuys offers sky-high value-add. The FlyGuys Mission Quality management approach ensures the best outcomes every step of the way, from job scoping, data capture, media processing and analysis to final delivery.

Consistency: Reliable quality, every time.

While LiDAR can produce surveys with unbeatable precision and exactness, that level of accuracy requires a robust Quality Assurance system. Capturing survey data is only half the battle in producing high quality scans; any drone service can collect raw data. Few render a deliverable that's immediately usable.

Unfortunately, most LiDAR services use a cloud- and subscription-based approach that relies heavily on automation but, unfortunately, delivers a product that either leaves a lot to be desired or requires a lot of additional processing by the client.

At FlyGuys, we take a white-glove approach to data processing that ensures a fantastic and instantly actionable dataset every time. Multiple people qualify the data – one to verify the dataset matches the scope of work, another to verify data accuracy, and only *then* does it go onto full processing. As a result, if there are issues at any stage, they can be identified, diagnosed, and fixed then-and-there, before it reaches the end-user.

We also offer multiple options for *how* to process the LiDAR data, based on the needs and desired deliverables for the project. For example, some customers need processed data that can immediately be uploaded into their own software system. In these cases, we can export in the appropriate format based on the client's needs and wishes. Altogether, FlyGuys uses a high-efficiency start-to-finish process including multiple touchpoints, seamless handoff, and white glove philosophy to ultimately delivering products with the goal of creating a raving fan.





Capability: Mastery of the technical dimensions

LiDAR is more technically complex than photogrammetry or traditional photos or surveys. It's not a "plug-and-play" style technology. Instead, implementing and executing LiDAR scans requires a deeper background in – and understanding of – survey knowledge. Data processing – or cleaning, filtering, and analyzing the point clouds generated by LiDAR – is also a complex endeavor that requires experienced and skilled data analysts.

At FlyGuys, we employ our own LiDAR experts, from pilots to technicians and analysts, whose knowledge and experience can directly benefit our clients. Our in-house expertise has allowed us to design a methodology that balances thoroughness and accuracy with efficiency and cost-effectiveness. We incorporate both drone-based scanning and some level of ground control and ground-check verification into the process. This technical complexity means that services that try to automate this process, despite advances in AI technology, cannot yet produce equally refined, precise, or usable deliverables for endusers – or come even close. People and their unique capabilities are still key in this arena.

We've also designed a data collection business model that's hard to beat and allows us to capture and deliver LiDAR data faster than almost any of our competitors.

1. We have multiple LiDAR units in-house that can be deployed at need, without necessarily having to subcontract out to outside parties, capable of scanning hundreds of acres per day.
2. However, if the in-house units are unavailable, we maintain a nationwide network of proven, trusted LiDAR-capable drone pilots. We use a bespoke ranking system that lets us know if a given pilot is truly qualified and a good fit for the intended job.
3. As a result, with that two-tiered system, we always have the capability to get a LiDAR pilot or team out to the site with zero-to-minimal delay.

Cost: Keeping project fees low.

LiDAR is not the cheapest technology to implement, but FlyGuys has designed an approach to LiDAR data collection that ensures it won't break any budget. In fact, we've intentionally designed our service to be affordable enough that our clients can potentially mark up the deliverable for themselves.

That's because the business model through which the LiDAR scanning is deployed matters as much as, or even more than, the technology itself in determining cost.

Plus, since FlyGuys does not use licensed land surveyors, nor offer formal surveying as a service, we do not have to account for the professional service fees that would otherwise accompany those services. The result: LiDAR service that's both at its best *and* at its most affordable.

IN THE END, LiDAR IS A POWERFUL PROBLEM-SOLVER.

Ultimately, LiDAR is a technology that resolves longstanding challenges anytime a surveyor, inspector, or other party needs to produce detailed, accurate scans, maps, and models of structures or landscape. **It improves surveying and scanning processes both quantifiably** (shortening project timelines, reducing labor costs and labor strain, and providing more precise models created and populated with more accurate data) **and qualitatively** (enabling new possibilities in deliverables, sales and bidding processes, and potentially even new business offerings). Regardless of how it's used, LiDAR reliably generates valuable and actionable insights that wouldn't otherwise be discoverable – and does so faster and more cost-effectively than traditional methods.

It really is a game-changer in the world of mapping, scanning, and surveying. As a result, it's important to realize that LiDAR is *also* a disruptor comparable to technologies like GPS – and one that will reshape the field of surveying and scanning to the advantage of those who adopt LiDAR in smart and effective ways.

No, this doesn't mean LiDAR will entirely replace other methods, like photogrammetry or ground-based survey crews, but LiDAR is fast becoming a *must-have* for modern survey and inspection projects. Indeed, in the right circumstances, different methods used together in creative combinations can achieve outputs that are greater than the sum of the parts – **more detailed, more useful, and more valuable.**

“LiDAR technology provides a comprehensive solution to surveyor challenges. With LiDAR, surveyors can collect data remotely, allowing them to complete projects faster and more efficiently.

“This reduces the need for large teams and manual labor, easing the strain on the labor force. Additionally, accuracy and speed enable surveyors to deliver more precise results, which improve project outcomes and reduce errors. By adopting LiDAR technology, surveyors can improve productivity, save time, and lower costs.”



JESSICA SLAUGHTER
National Account
Manager, FlyGuys

NEXT STEPS



Learn more about industry-specific applications by downloading the white paper, **“Drones: Driving a New Standard of Operational Efficiency.”**

Review the accuracy and comprehensiveness of drone-procured data first-hand by requesting a sample dataset at info@flyguys.com.

If you already have a project in mind, get more information and request a quote [here](#).

ABOUT

FlyGuys is a nationwide drone services company that acquires aerial imaging data so you can make more informed, accurate decisions. Our aim is to make aerial data more accessible and affordable, so you can overcome challenges efficiently and safely.

From RGB and Infrared, to LiDAR and Hyperspectral sensors we can collect it all. With our geospatial experts and vast network of drone pilots, we are ready to deploy when and where you need us, using drones, helicopters, manned fixed-wing aircraft, and terrestrial collection methods in order to provide you with the resources you need at an affordable cost. We deliver aerial data collection solutions for many commercial industries and public sector entities including Energy, Agriculture, Construction, Engineering, Transmission & Distribution, Transportation, and more.

We are committed to providing excellent client service and quality professional solutions to meet and exceed our client's expectations. Our attentiveness to project requirements, combined with the experience we have on our team means that we are able to take on projects of any complexity.

If you need a quote for a drone imaging project, we'd be happy to help.

[Get A Quote](#)

CONTACT

ADDRESS

FlyGuys, Inc.
Corporate Headquarters
120 Clinton St.
Lafayette, LA 70501

PHONE

(888) 376-6965

EMAIL

info@flyguys.com

LEARN MORE

www.flyguys.com

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