Advancing Technology for Roof and Building Measurement

By James Gillett

The measurement of roofs and buildings is now light-years beyond a tape measure and camera. Through a combination of off-site and on-site technologies, roof consultants, contractors, and adjusters can get a complete picture of a roof or building to suit their business needs. Existing and emerging technologies allow the digital recording of roof and building elements and the manipulation of the information to assemble exactly the needed report. Let's look at where we are and where we're going.

OFF-SITE

The past five years have seen the widespread acceptance of **aerial imagery reports** for both residential and commercial roofing (*Figure 1*). At first, many roofers, adjusters, and consultants were skeptical that these reports could be used reliably in their business models. Today, the reports, available from a select number of vendors, are the standard method for gathering roof measurements, and they save countless hours and thousands of gallons of gas. The technology has been proven reliable and is in widespread use by both large and small businesses. The unknown has become the known.

Up until now, the main source of data used for aerial imagery reports has been photographs taken from either an airplane or a satellite, with the metadata[1] being used to build the roof model. While this method is very accurate, it also requires a high degree of human interaction and is highly dependent on the quality of the photograph. In general, the greater the number of pixels in the photo, the higher the accuracy of the roof model. Quality is also affected by the amount of foliage on the trees, the strength of the shadows in the image, and the time of year of the photograph. But there is a newer and potentially more accurate method of aerial measurement that will be used soon: **lidar**.

Lidar, a combination of light and radar, uses a laser mounted in a specially outfitted airplane to map roofs (and anything else) and can build a 3-D model of a roof almost instantly (*Figure 2*). The laser scans the area and, based on distance from the source, constructs a 3-D wireframe of the roof. No longer do shadows or foliage matter. The laser is able to scan through the foliage and, in fact, can map the tree location also, which can be useful in solar reports to show potential light blockages from trees. Lidar does require sophisticated software to construct the roof model.

As is often the case with newer technology, it still requires a person to check the model, but the amount of labor is greatly reduced. And although lidar has been around since the 1960s (it was used to map the lunar surface during the Apollo 15 mission), it is only now that the accuracy, cost, and computing power have aligned to make it a feasible, effective technology for


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Report Summary

ROOF MEASUREMENTS SUMMARY	
Total Area (Sq)	291.49
Pitched Facet Area (Sq)	218.14
Flat Facet Area (Sq)	55.89
Parapet Area (Sq)	17.46
Parapet Length (Ft)	328
Parapet Width (Avg. Ft)	1.03
Parapet Height (Avg. Ft)	3.75
Primary Pitch	6:12
Ridges (Ft)	343
Hips (Ft)	502
Valleys (Ft)	568
Rakes (Ft)	285
Eaves (Ft)	993
Rakes + Eaves (Ft)	1278
Apron Flashing (Ft)	476
Step Flashing (Ft)	20
Total Skylights	0
Total Chimneys	1
Total Number of Structures	1
Total Number of Facets (Roof planes)	42

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Figure 1 – Courtesy of SkyMeasure by CoreLogic.

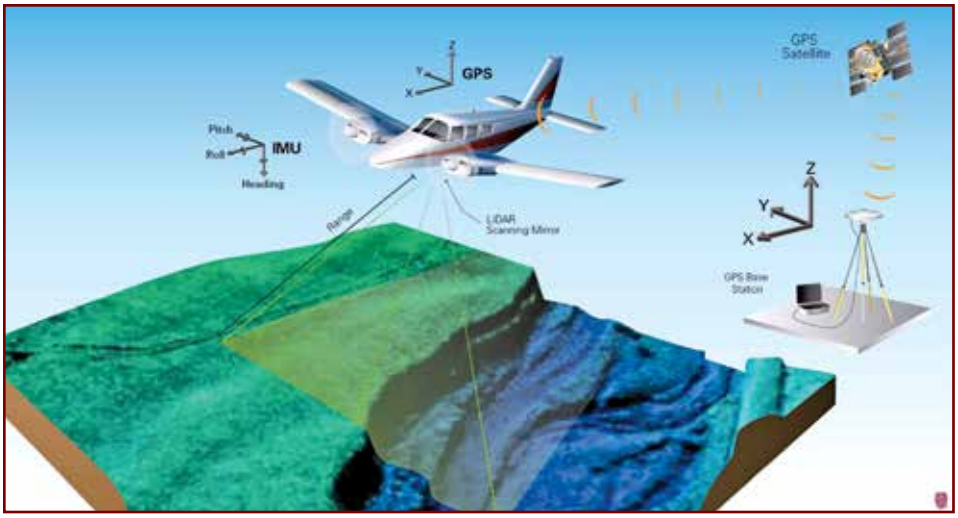

Figure 2 – Director of Remote Sensing Amar Nayegandhi of the University of South Florida explains the science and technology behind light detection and ranging (lidar) services. See https://www.youtube.com/watch?v=eBUCGxZq_xg.

aerial imagery reports. However, since the technology requires the use of airplanes and pilots to fly the country, it will still be a while before the imagery catalog can be updated with lidar imagery.

Another new technology that we hear about every day lately is **drones** or **unmanned aerial vehicles (UAVs)**. UAVs (*Figure 3*) would seem to be a perfect fit for the production of aerial imagery reports. Since they do not have to carry a human being, they can be smaller, lighter, and fly farther using less fuel. They can also fly at lower altitudes and, potentially, to more remote areas. The technology is evolving rapidly, but Federal Aviation Administration (FAA) regulations concerning drones are moving much slower. Given the fact that UAVs' use must coexist with the current fleet of commercial airlines and private airplanes, it will be a slow phase-in of the use of UAVs. It is understandable that rules regarding their use need to be carefully considered to minimize loss of equipment and, in the worst-case scenario, human life, whether in the air or on the ground.

After FAA regulations are established, there should be a multitude of uses within the industry, both on- and off-site. Larger drones will be used for state, regional, and country imaging, while smaller drones will be used by individuals to get extensive information on-site without having to get on a ladder. The possibilities are numerous and will rapidly evolve.

[Editor's note: See the article on UAVs on page 13 of this issue of *Interface*.]

ON-SITE

Despite all of the available technology for imaging roofs (and, to some extent, walls), there are additional on-site technologies that can be used now to aid in the measurement of roofs and buildings. One of the main tools that you probably have in your pocket—the **smartphone**—will be used in many new and creative ways to help you measure and identify roof and building conditions. Scanning and recognition software and devices with advanced vision capabilities are evolving rapidly and will soon be incorporated into smartphones or made available as stand-alone devices that can identify a variety of conditions (think the Tricorder from Star Trek, only for buildings).

One of the simplest uses for a smartphone is to determine the roof pitch. There are numerous apps that use the gyroscope present in every smartphone to determine the pitch—either from the ground or resting directly on the roof. Additionally, there are a host of "smart tools" such as distance measurement, levels, protractor, vibrometer, and even metal detector that use the existing sensors in your smartphone to provide a more complete analysis of a building.

[Editor's note: See the article on the *Interface* Peer Review Committee members' favorite phone apps on page 32 of this issue of *Interface*.]

As useful and interesting as those smart tools are, one of the most useful technologies to come along is **advanced vision capability**. This technology uses a multitude of sensors and cameras to enable users to walk through a space and build a

Figure 3 – Unmanned aerial vehicle or drone (photo courtesy of Joe Carson).

3-D model as they walk. Imagine being able to walk across a roof and have an instantaneous model of all the roof penetrations, HVAC units, curbs, and parapet heights. Everything is located exactly without using a tape measure—and no drawing is time required!

Similarly, advanced vision capability in concert with **element recognition technology** could make it possible to identify the manufacturer and model or type of windows, siding, shingles, etc. As the sensors scan the walls of the building and assemble the 3-D model, the element-recognition software could compare the size, shape, and texture of a building element against a manufacturers' database and determine the type or exact model number. Over time, manufacturers could even design in an unobtrusive "marker" that only the software could identify, making it more likely an exact match would be identified.

Additionally, **color spectrum analysis** of the siding or other elements should make it possible to identify the paint colors used and offer the closest matches from a variety of manufacturers—all without having to remove a small sample of the material and have it color-matched.

As smartphones evolve and components get smaller and less expensive, the sensors needed for many of these technologies will be incorporated into the phone and make it possible to perform complete roof and building analyses with just one device. You'll have a lab in your pocket!

Another upside to all of this technology is that the data that are collected can be stored in a database as a record of the building and retrieved quickly and easily. The building owner can maintain the digital data for the property as well as keep a copy with facilities managers and building consultants, which can greatly reduce administrative time in finding specific information in the event of a catastrophe or for general maintenance. It also makes it possible to keep video records of specific fixes or problem areas in case of personnel turnover.

CHEAPER, FASTER, AND BETTER ARE POSSIBLE!

It's often said that you can get two of three but not all three. Now, however, with the combination of off-site technologies such as aerial imagery reports and on-site technologies such as advanced vision capabilities, roof consultants, adjusters, and contractors can gather a more complete and accurate assessment of the building in less time at lower cost. And it should only get better from here.

FOOTNOTE

1. Chris Rutter, "What Is Metadata?: Copyright Photos in 4 Steps," *Digital Camera Magazine*. Future Publishing. "Metadata may be written into a digital photo file that will identify who owns it, copyright and contact information, what camera created the file, along with exposure information and descriptive information such as keywords about the photo, making the file searchable on the computer and/or the Internet. Some metadata is written by the camera, and some is input by the photographer and/or software after downloading to a computer."

James Gillett

James Gillett is the client services manager for SkyMeasure by CoreLogic. He graduated from the University of Michigan with an M.S. in architecture. He has 20 years' experience in the architecture industry, and five years' experience in the aerial imagery industry in both production and marketing. Currently, he manages over 200 customer accounts directly and guides customer relations policy and procedures.

Metal Roofing Grows

The market for metal roofing has grown 7.1% for new construction and 4.1% in replacement roofing in the five years from 2009 through 2014, according to an industry study released by the Metal Construction Association (MCA). In the commercial sector, metal roofing grew 9.7% in the five-year period. The industry also saw an 8.7% growth in metal wall panels in commercial building during this time.

Study participants included data from the American Iron & Steel Institute (AISI), the Aluminum Association (AA), Metal Roofing Alliance, the National Frame Building Association (NFBA), and the National Coil Coating Association (NCCA).