Estimating how much green vegetation covers the ground surface is tedious work, but a new tool promises to make this vital task considerably quicker and easier. Writing in the November–December 2015 issue of Agronomy Journal, Oklahoma State University (OSU) researchers describe “Canopeo”: a free, desktop or mobile app that estimates green canopy cover in near-real-time from images taken with a smartphone or digital camera.

In experiments in corn, wheat, canola, and other crops, Canopeo calculated percent canopy cover dozens to thousands of times faster than existing software, without sacrificing accuracy. And unlike other programs, the app can acquire and analyze video images, says Oklahoma State University soil physicist, Tyson Ochsner—a feature that should reduce the sampling error associated with canopy cover estimates.

“We know that plant cover, plant canopies, can be quite variable in space,” says Ochsner, who led the app’s development with doctoral student, Andres Patrignani. “With Canopeo, you can just turn on your [video] device, start walking across a portion of a field, and get results for every frame of video that you’re recording.”

Among the first uses the pair sees for Canopeo is helping producers judge when to remove grazing cattle from winter wheat in “dual purpose” systems, where wheat is also harvested for grain. Research by others at OSU found that good grain yields could be achieved by taking cattle off fields when at least 60% green canopy cover remained. “So, Canopeo would be useful for that decision,” Patrignani says.

He and Ochsner also think the app could find use in turfgrass management; in assessments of crop damage from weather or herbicide drift; as a surrogate for the Normalized Difference Vegetation Index (NDVI) in fertilizer recommendations; and even in forests or aquatic systems. Indeed, it’s hard to predict all the uses, Patrignani says. “As with other tools, we expect people to find applications beyond our initial expectations.”

Simplicity Equals Speed

Patrignani’s original expectation for Canopeo was just hoped it would make life easier in the lab. To track seasonal development of the crop canopy in field experiments, he and research assistants Jordan Beehler and Michelle Melone were using software that was accurate but also taxing to work with—requiring them to manually classify as “green” or “not green” up to 200 pixels per image. So when Patrignani said he could find a way to do this automatically and Beehler and Melone agreed to help, Ochsner told them to go for it.

“They were all looking for a way to escape the tedium of having to do it by hand,” Ochsner says with a laugh.
Rather than requiring a person to make the call, their solution places every pixel in an image into the same “green” or “not green” categories according to selection criteria based on color thresholds. The algorithm it employs for this is simple but effective, and in fact “the simplicity of the processing routine” is what gives Canopeo its speed, Patrignani says. In the Agronomy Journal study, for example, Canopeo quantified green canopy cover 75- to 2,500-times faster than SamplePoint, the program used by Ochsner’s group previously. Moreover, Canopeo correctly classified 90% of the pixels compared with this “gold standard” method.

In the end, though, Canopeo was still tied to a desktop computer, so Patrignani next turned to the OSU App Center to commission a mobile application for smartphones. The center’s student programmers translated the desktop code into Apple’s iOS mobile language while graphic designers built a user interface. Meanwhile, a computer science student, Marcus Gabilheri, was hired to develop an Android version and create a website (www.canopeoapp.com) where users can store photos and data in individual accounts.

The data associated with analyzed images is another key to the app’s value, Patrignani says. Canopeo automatically stamps each image with geographic coordinates and time and date, and then users can add personalized notes. Users can also reanalyze images stored on their phone or computer.

The team is now exploring whether Canopeo’s percent cover estimates can inform soil moisture models. Farmers often ask for soil moisture information for fields where no actual moisture measurements have been taken, Ochsner explains, which is why the researchers rely on modeling. But to predict soil moisture, the scientists need information on what crop was planted and when, how the crop is doing, and so on. This information can come from Canopeo.

“So that’s the thought process,” Ochsner says. “Can we use the information that growers provide [through the app] to give them back some additional information on how much soil moisture they may have available in their root zone? We can’t do that yet, but we think we’re getting close.”

In the meantime, he’s spreading the word as much as possible and is excited to see where Canopeo goes next. “The more users we can get, the better off I think we’ll be in terms of seeing the research have impact.”

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