NIRAV PATEL

Open Source Data Programs From Low-Earth Orbit Synthetic Aperture Radar Companies

Questions and answers

Synthetic aperture radar (SAR) imaging data in general have not been openly accessible for consumption to the general public in the past few decades, as mainly governments have led the development of such platforms, due to the commercial industry lacking the need of such data (with few exceptions).

When commercial remote sensing platforms for electro-optical imaging became more mainstream for outside industries to consume in the 2000s and the 2010s, it would only be a matter of time before the size, weight, and power constraints would enable the commercial industry to build and operate small satellites with an imaging capability from SAR, also allowing for open data programs to be created by companies that work with their business model.

As of this writing, the author of this piece is aware of two open data programs by two SAR companies currently operating satellites in low-Earth orbit. The two companies that run these open data programs are Capella Space Corporation (headquartered in San Francisco, CA, USA) and Umbra Lab Inc. (headquartered in Santa Barbara, CA, USA).

I had the opportunity to ask both companies some questions and received some insightful answers. We (the IEEE Geoscience and Remote Sensing Society, GRSS) greatly appreciate both companies in participating in this written interview.

GRSS: How did your company get started? Why start a company in small-satellite SAR?

Capella Space Corporation: The growth of the commercial space industry and advances in cloud computing led to the smallsat revolution that has produced a wealth of information from space. However, most companies and governments have relied on optical satellites, which face significant challenges in timely and reliable Earth observation. Optical imaging, which is the current go-to for Earth imaging, is limited to cloud-free, daytime conditions. This limitation means 75% of the Earth remains undetected (half of the Earth covered in clouds, half of the Earth in darkness) no matter how many optical satellites are launched in space.

In 2016, Capella Space was founded to enable a richer understanding of our planet in entirely new and powerful ways. The company saw an opportunity to use SAR to monitor the Earth 24/7, including the 75% that is either covered in the darkness of night or obscured by clouds.

> *When Malaysian flight MH370 went missing, the world's superpowers could not locate this plane with all of their assets. We thought that more could be done to monitor this one planet and home that we have.*
>
> —Payam Banazadeh, CEO and founder of Capella Space

Today the company is building the next generation of SAR sensors to develop a constellation that improves decisions about commerce, conservation, and security on Earth.

Umbra Lab Inc. (Joe Morrison): David Langan had the idea for Umbra based on a couple of technical insights after working on massive, exquisite systems for the U.S. government; one of those insights is patented (the antenna) and the rest are trade secrets. He went to his childhood friend, Gabe, who was a successful entrepreneur already by that point and they teamed up to start the company about eight years ago.

The fundamental thing Umbra unlocks is the ability to capture a high volume of very, very high-resolution

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data using a form factor that is quite inexpensive compared to historical missions of a similar specification. The average system that can capture 25-cm X-band data in the ground plane costs about as much to operate each year as Umbra has raised in its entire history as a company. And that's just one satellite. We have six satellites in orbit already; seven and eight launch later this year (Figure 1).

GRSS: Why is running an open data program important to your company?

Capella: Capella's mission is to make SAR more accessible, demonstrate its unique value, and help solve the hardest challenges we face on Earth. To do this, we are working with a broad community of the brightest data scientists and software engineers.

Our collective efforts and imagination are unlocking the most value from these data to transform how we live. Capella's open data program is part of the tiered Capella SAR community (open data, data cooperative, and data grant). The community program enables users to have increasing access to SAR data, and to help them develop tools and algorithms to solve complex and urgent problems.

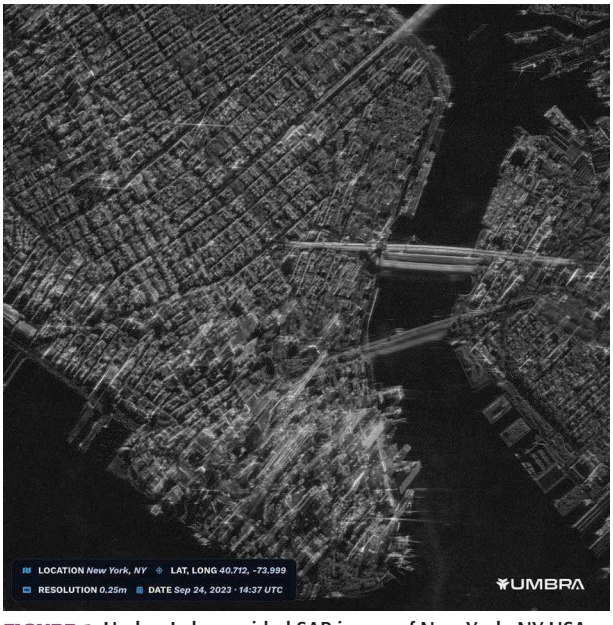

FIGURE 1. Umbra Lab-provided SAR image of New York, NY USA.

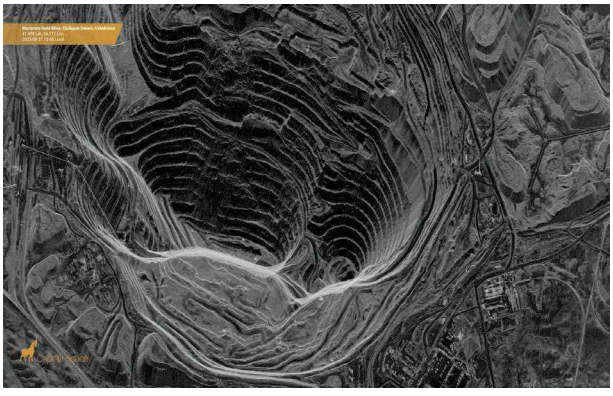

FIGURE 2. From Capella Space Corporation SAR: image of the Muruntau gold deposit, which is situated in the Qizilqum Desert of Uzbekistan. It is being mined in the world's largest open-pit gold mine with production believed to be of the order of two million ounces per annum.

Capella's open data is a continually growing, timely dataset that consists of hundreds of images, covering every continent with examples from agriculture and aquaculture, energy and natural resources, infrastructure, maritime, environmental, as well as humanitarian and natural disaster use cases (Figure 2). With the creative commons license, this makes Capella's data ideal for computer vision and machine learning research and development.

Umbra: If you can make something just as good or better than what others offer for one-tenth the cost, you have two basic strategies to consider pursuing:

- You can artificially constrain supply and try to sell data at similar prices to historical norms, just with a much better margin. In this strategy, you are using an arbitrage to siphon cash from an existing market.
- You can use your supply advantage to flood the market and try to grow it overall (not just for yourself) by finding new markets and customers (and sucking the margin out of your competitors' businesses at the same time).

We've opted for the second option, because we believe the commercial market for high-resolution SAR data is essentially nascent, but will be very large in the future based on both advances in technology—like cloud computing, artificial intelligence—and demand-driven by climate change.

We've released more open data than all of our competitors combined. In fact, we probably release more data each month than all of our competitors have released in their history. We are seeding opportunity for entrepreneurs who want to find novel applications for these data without having to spend hundreds of thousands of dollars speculatively to test their ideas.

GRSS: Does running an open data program make good economic sense?

Capella: Yes. When Capella was founded more than seven years ago, very high-resolution SAR was a rare commodity that was available almost exclusively to specialized governments and research intuitions with large budgets. The community program is designed to give very high-resolution, ultralow latency data directly to researchers, nonprofits, developers, and disaster response organizations to foster innovation and discover the next game-changing applications of SAR.

Today, the community program, which includes our open data offering, has proved mutually beneficial for both Capella and our research community, as these users uncover new use cases and applications for high-quality, high-resolution SAR imagery. Already we have had early adopters reach out expressing interest in commercializing automated detection algorithms and machine learning

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models built using Capella's open datasets for use cases, ranging from oil spill detection and deforestation monitoring to infrastructure damage assessment. But ultimately the community program is helping Capella reach one of its core missions: to make SAR data more accessible.

Umbra: We could spend US$10,000 a month on advertisements on social media and hope it reaches our target audience like the industry likes to do…or we could give a journalist or intrepid entrepreneur two free images (that cost us ~US$0 in extra marginal expense) and the resulting analysis they do gets seen by tens or hundreds of thousands of people who sought it out organically. I think it's a much better return on investment from an objective lead-generation point of view, but in addition, it helps us build intangible good will in our brand, which helps not only with sales efforts but with recruiting as well.

One more nuanced point: There's a famous concept that I love called *commoditize your complement*, and to summarize crudely, it means that if you can open a technology to a broad audience that undermines a competitors' position in the market, you can find very "cheap" tactics for you that are very "expensive" for them.

Our competitors are trying to do analytics themselves, and by giving open data away we arm the rebel entrepreneurs in the myriad niches where SAR can be applied such that everywhere our greedy competition turns there are one or two companies competing with them, often with technology they were able to bootstrap very inexpensively by leveraging data we released openly and freely.

GRSS: What does your open data program currently offer?

Capella: The Capella community program offers open data through three different tiers to meet the needs of different researchers and use cases.

Tier 1: Open data: Anyone interested in getting started with SAR can access Capella's diverse open dataset through the open data program. This dataset includes imagery from all of our imaging modes (spotlight, sliding spotlight, and stripmap) and consists of geographically diverse areas of multiple land cover and land use types. All complex and detected data products are accessible through tier 1. Anyone can download the program's available high-quality SAR imagery for free from the Capella Open Data Gallery page, our self-serve Capella Console, or the Open Data AWS S3 bucket published via the AWS open data registry.

Tier 2: Data cooperative: Data cooperative participants can request access to archive imagery beyond what is in the open data dataset, to meet their specific needs. Participants are entities that Capella wishes to empower in the development of new use cases, applications, and processing/exploitation methods or defining new market verticals. Capella works closely with data cooperative participants to grant them archive access on a case-by-case basis for their area of interest. Capella works with participants to broadly share their findings with the world through channels, such as blog posts and scientific papers.

Tier 3: Data grant: Capella's data grant takes access one step further and provides limited tasking capability for qualified applicants whose areas of interest are not currently covered by Capella's archive catalog. Participants are researchers with novel, high impact, and/or important missions.

Umbra: We have 25 sites around the world that we monitor persistently; they range from research farms, to active mines, to airports, to sea ports, to major cities. We also have an ad hoc folder that is a grab bag of collections driven by current events or locations of unique intrigue. You can find everything from 16-cm to 1-m spotlight data in there. And most collections include not only the detected product (the .tiff) but also the complex product and the phase history, which was literally illegal for us to share only a few years ago. Exciting times!

GRSS: How can readers get in contact with your open data program and associated data?

Capella: Readers can visit the Capella Space Community page for a full description of the different tiers and to access open data imagery, either through the Capella Gallery or an AWS S3 bucket. Intake forms are available on the website to apply for the data cooperative and data grant. Users can get in touch with the team directly by emailing community@capellaspace.com.

Umbra: We have links on our website to the open data and AWS hosts all of it for free in the open data registry. You can also use the "contact us" form to reach out about it and suggest new sites we should monitor or request specific samples to support your research or ongoing work.

Ultimately, though, our goal is not to have a large group of people relying on our charity. We want to bring the cost and technical barriers to using SAR in research and humanitarian fields to a point where it is sustainable to pay for it.

That's the future I want to live in: one where the average student with a small research grant can leverage it for custom collections to reveal some new facet of their field of inquiry or build some new tool that unlocks value for their audience. The open data are just the start.

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AUTHOR INFORMATION

Nirav Patel (niravpatel@ufl.edu) is an affiliate faculty member in the Department of Geography at the University of Florida, Gainesville, FL 32611 USA. He is also a senior scientist in the Office of the Secretary of Defense at the U.S. Defense Innovation Unit Mountain View, CA 94043 USA, and a program manager for open source/non-International Traffic in Arms Regulations restricted remote sensing efforts.

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