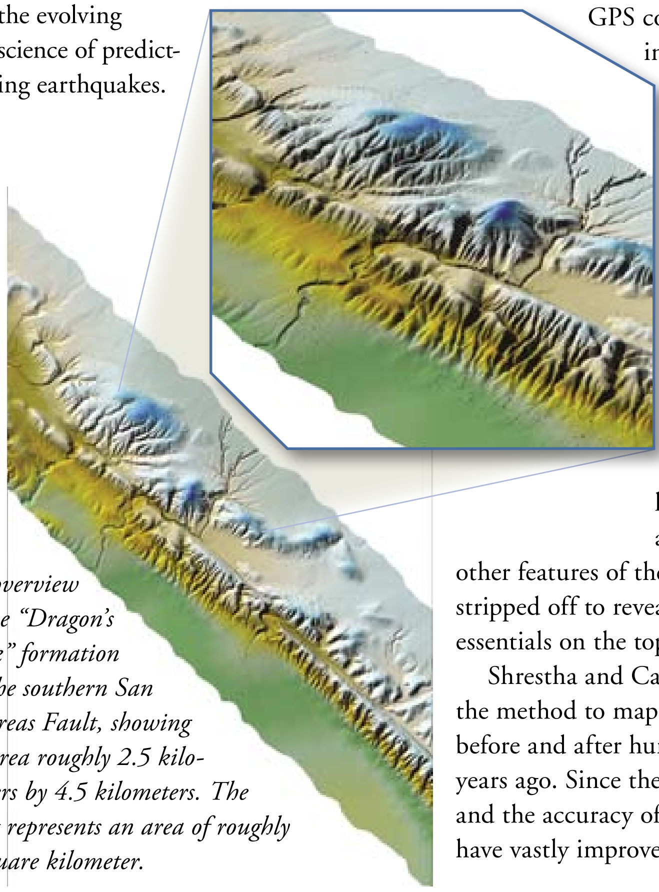
UF Engineers Mapping San Andreas Fault

A UF-led project to map California's San Andreas Fault could bring the dream of forecasting earthquakes a bit closer to reality.

Engineers with UF, the University of California, Berkeley and other institutions recently wrapped up the second half of a two-year effort to produce the most detailed-ever map of the 1,200-mile-plus fault and immediate adjacent terrain.

By comparing the map with similar maps created after future earthquakes, seismologists will be able to determine all the earth movements around the affected region of the fault much more quickly and accurately than with traditional surveying tools.

That information will not only shed light on the magnitude and location of the quake but also will be important to the evolving science of predicting earthquakes.



An overview of the "Dragon's Back" formation on the southern San Andreas Fault, showing an area roughly 2.5 kilometers by 4.5 kilometers. The inset represents an area of roughly 1 square kilometer.

"We're making it possible to get very accurate data on how much the earth around the fault is displaced during an earthquake," said Ramesh Shrestha, a professor of civil engineering at UF and director of the UF-based National Center for Airborne Laser Mapping. "Seismologists can quantify that information and input it into their equations and models and ultimately try to better predict earthquakes."

Shrestha and Bill Carter, an adjunct professor in civil engineering, helped to pioneer the mapping method at the heart of the project, called airborne laser swath mapping.

A small airplane carries a laser that emits thousands of pulses of light each second toward the ground. The pulses hit and scatter back to a sensor, allowing software to gauge the distance between the plane and the terrain, pinpointing the altitude of each target point. When combined with GPS coordinates gathered in part by ground crews, the system also allows the software to determine the latitude and longitude of each identified point.

The result: a highly accurate three-dimensional map that looks something like a photograph, although trees and other features of the terrain can be stripped off to reveal only the bare essentials on the topography.

Shrestha and Carter first used the method to map Florida's beaches before and after hurricanes nearly 10 years ago. Since then the technology and the accuracy of the resulting maps have vastly improved. Clint Slatton, an assistant professor in electrical engineering, joined NCALM in 2005 and develops algorithms to extract surface features from the data.

Whereas the first laser fired 5,000 pulses per second, a new $1.4 million laser used for the first time on the San Andreas Fault project can fire up to 167,000 pulses per second. As a result, scientists can gather elevation, latitude and longitude data for each of 10 to 15 points per square meter, or about 1.2 square yards. That compares to just 1 or 2 points of the original unit.

"You're sampling the surface more densely, and therefore you can make a higher-resolution map," Carter said. "It's kind of like we had 20-60 vision with the old laser and we have 20-20 vision with the new one."

Flying at an altitude of 2,000 feet, a pilot and crew member aboard UF's Cessna 337 made repeat passes over a selected section of the fault — each section extending about 31 miles in length. A GPS satellite receiver and an inertial measurement unit onboard the aircraft track the plane's location and orientation relative to the .62-mile-wide area being mapped.

"The plane makes five or six overlapping passes to cover a typical section. It's a little like mowing the grass," Carter said.

Historically, seismologists have mapped before- and after-earthquake movements using traditional surveying tools, a time-consuming and slow process. Once the current map is completed, they can simply remap the affected area to note the changes.

The project is sponsored by the National Science Foundation, which has provided nearly $500,000 to map the critically important San Andreas Fault and nearby faults.

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