OptiTrack

Installation Profile

Verdure Imaging/SpineUS

Highlights

Location
Stockton, California

Industry
Medical Imaging

Applications
Spinal Diagnostics

Pioneering a 3D Ultrasound Imaging Application for Spinal Diagnostics

Many innovators have developed new technologies from the ground up, while others find ways to combine existing advancements to solve problems in entirely new ways

The idea for 3D ultrasound diagnostic imaging of the spine first took root when Chris Schlenger, CEO of Verdure Imaging, saw an ultrasound image of his daughter's face in utero. After her birth, he was struck by the accuracy of the technology. A chiropractor by trade, Schlenger wondered why ultrasound wasn't used to visualize spinal structures.

"I thought, 'If we could just see the surface of the spine, it would really help inform what kind of chiropractic care to provide a patient,'" he said.

Upon exploring the idea, he soon discovered why. Ultrasound waves do not effectively penetrate bone and tend to bounce away from detectors, making it difficult to capture clear images of the bone surface. Still, his curiosity persisted, leading him to explore tracking as a way to enhance 2D ultrasound images into more accurate 3D renderings.

“There are a couple of methods to track ultrasound in a medical environment,” Schlenger explained. “One is electromagnetic tracking, which works well for very short distances. But for our purposes, optical tracking was the best option because it allowed us to cover larger distances and incorporate multiple cameras.” However, finding a viable tracking solution was initially challenging. The application needed to track a handheld ultrasound scanner as it moved along the spine, bending and twisting to capture dimensional imagery. “From a technical standpoint, we needed a system accurate enough to track both off-angle and several feet across the spine,” Schlenger said.

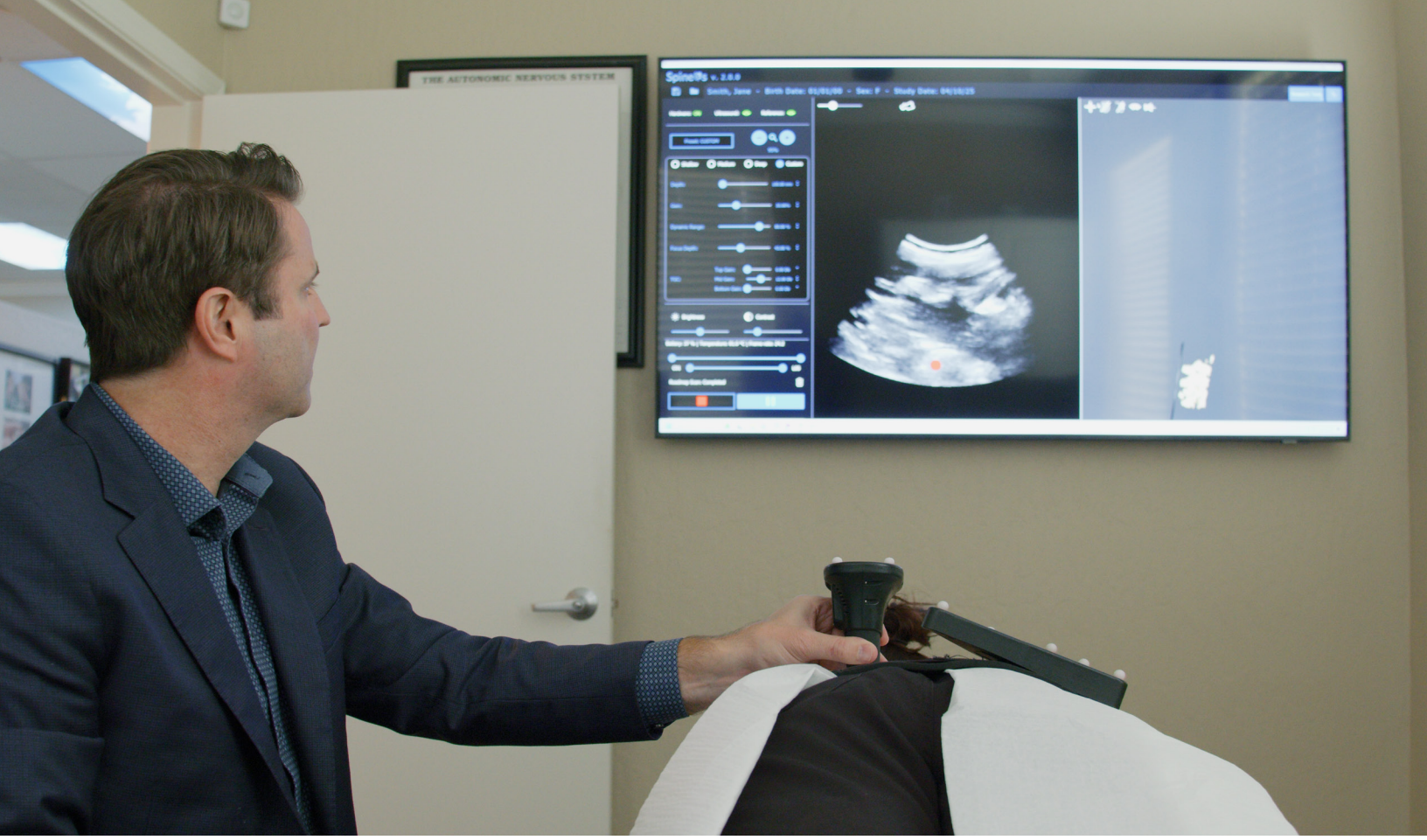
Schlenger partnered with the Laboratory for Percutaneous Surgery at Queen’s University in Kingston, Canada, which was prototyping an ultrasound-guided intervention system for translational clinical research.

Through the university’s connections he explored different options. None were able to meet his needs and requirements until one of the university’s team members directed him to OptiTrack, where he found the ideal solution. “OptiTrack provides any tracking configuration you need — whether it’s wide or narrow angle, a large or small room, or active or passive tracking,” Schlenger said.

Tracking Precision for 3D Imaging

Schlenger’s 3D spinal ultrasound imaging application — named SpineUS — features an OptiTrack system with three Slim^{x} 13 cameras and a handheld ultrasound scanner equipped with active LED markers housed in diffuser spheres. The setup also includes a consumer PC running the SpineUS application and a tracker reference device with LED markers secured to a patient using a Velcro belt. OptiTrack’s Motive software enables seamless integration between the tracking system and the SpineUS application.

Ultrasound imaging data captured by the scanner is transmitted via wifi to the SpineUS computer application during a recording session. Simultaneously, the OptiTrack system tracks the scanner’s motion via the LED markers relative to the reference tracker.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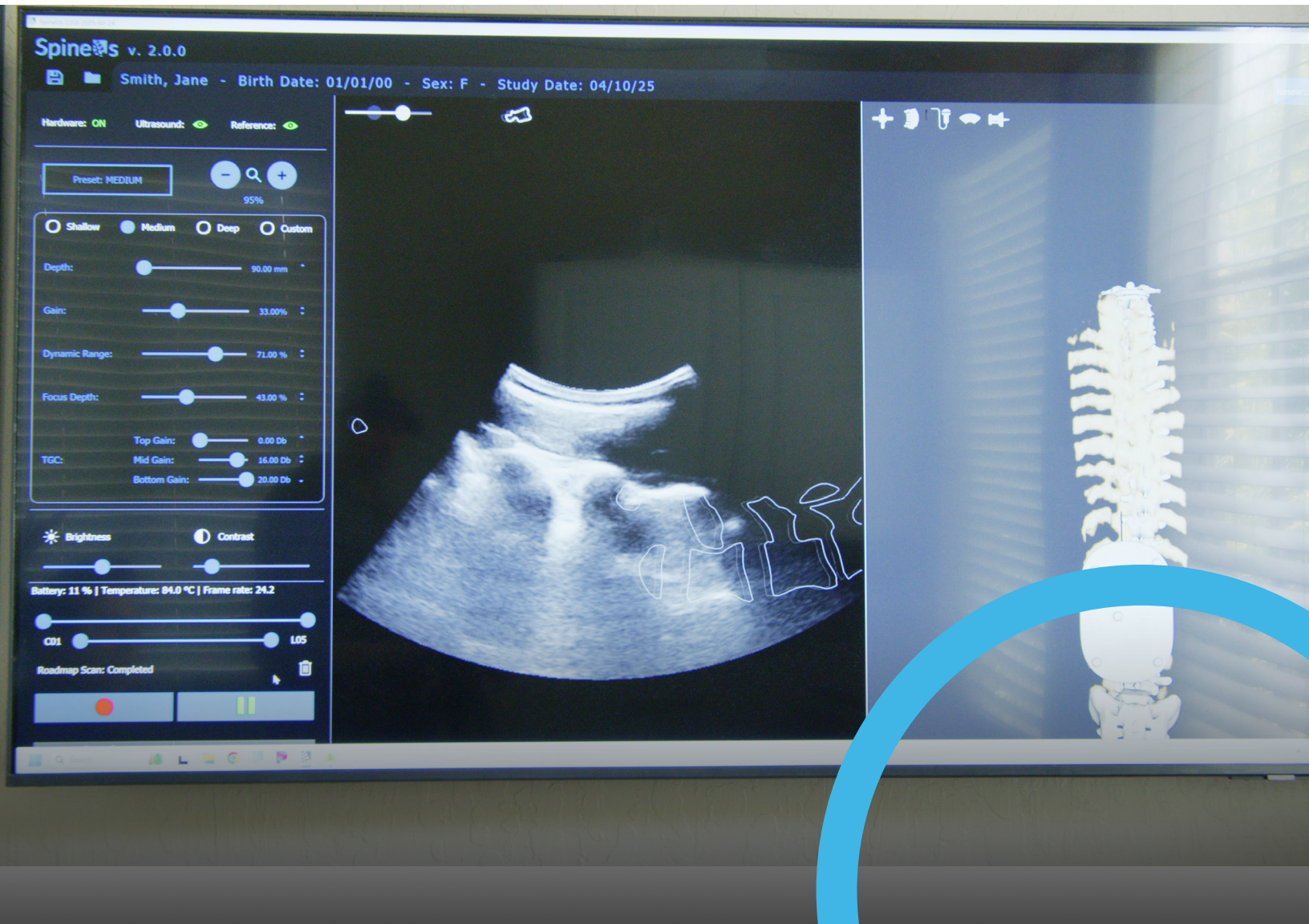
Spine Us v. 2.0.0
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Ultrasound:
Reference:
Preset: MEDIUM
95%
Shallow
Medium
Deep
Custom
Depth:
90.00 mm
Gain:
33.00%
Dynamic Range:
71.00 %
Focus Depth:
43.00 %
TGC:
Top Gain:
0.00 Db
Mid Gain:
16.00 Db
Bottom Gain:
20.00 Db
Brightness
Contrast
Battery: 11 % | Temperature: 84.0 °C | Frame rate: 24.2
C01
L05
Roadmap Scan: Completed

The SpineUs software application installed on the PC interacts with both OptiTrack's Motive motion capture software and the ultrasound scanner's firmware. By assigning tracking data to each captured ultrasound image, the software effectively synchronizes the ultrasound imaging data with the tracking data obtained through Motive.

"The LED spheres emit a unique marker pattern that OptiTrack tracks," Schlenger explained. "We then calibrate the tracking data from the ultrasound scanner relative to the reference. To accomplish that, we designed a tool to determine where those points exist in space, creating a coordinate system."

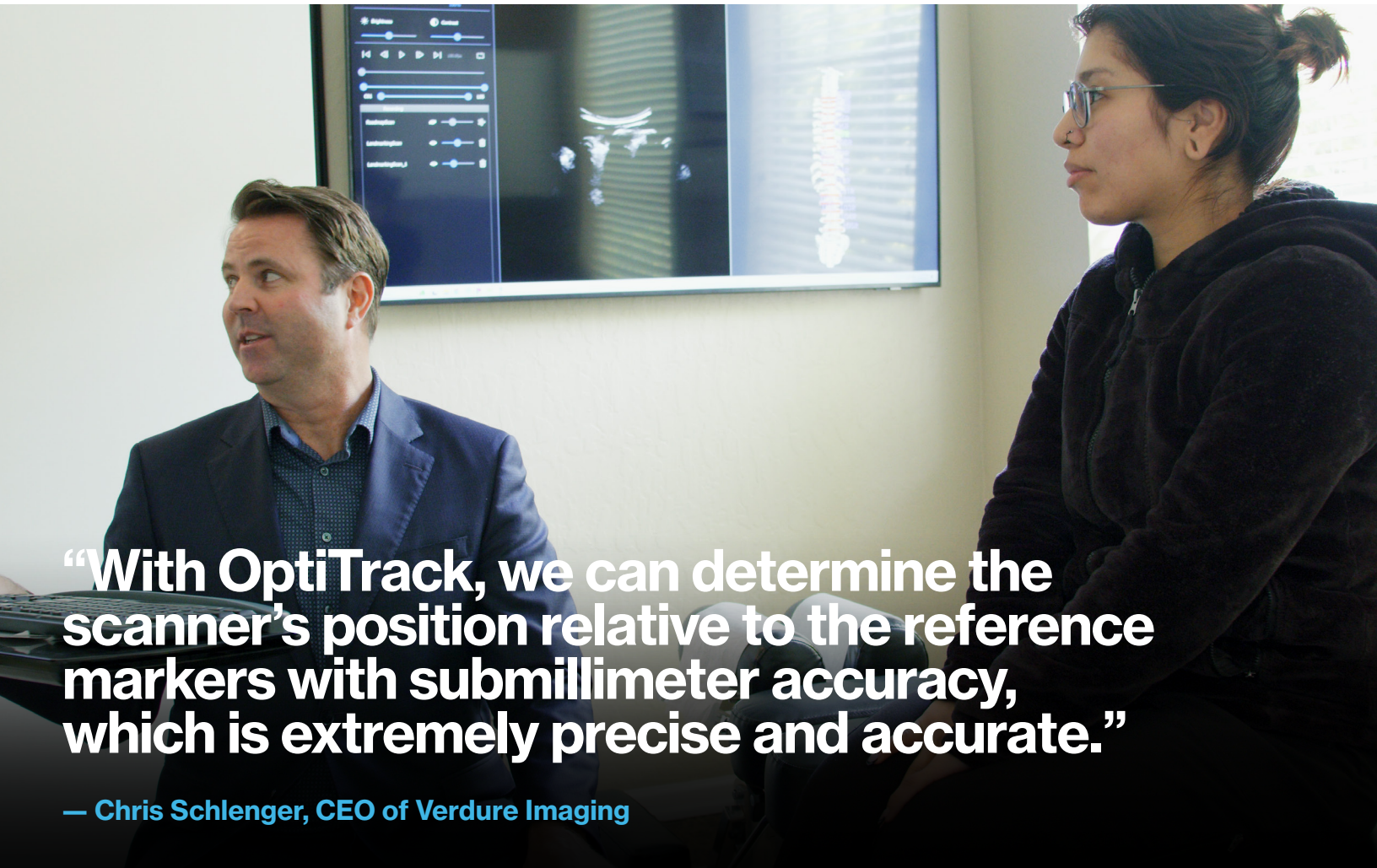
As the ultrasound scanner shifts and rotates along the spine, OptiTrack captures six degrees of motion. "With OptiTrack, we can determine the scanner's position relative to the reference markers with submillimeter accuracy, which is extremely precise and accurate, " Schlenger said. "This level of reliability is crucial, as it ensures more valid measurements for diagnoses like scoliosis analysis."

AI Integration

The capabilities of AI presented a tremendous breakthrough. Schlenger and his team discovered they could leverage AI-powered real-time algorithms to enhance the clarity of their 3D ultrasound images, enabling clearer visualization of the spine's surface.

"AI is so good at analyzing large volumes of data in a very short time," Schlenger said. "It can process over 22 frames per second. It's phenomenal how quickly AI can analyze an entire frame and accurately reconstruct it in a 3D context." This all happens in near real-time.

This marked a major turning point. Schlenger now envisions applications extending beyond spinal imaging. "Tracking combined with AI will revolutionize ultrasound diagnostic imaging," Schlenger said. "Traditional ultrasound images can be raw and noisy, but now we can enhance them to reveal detailed structures, potentially opening the door for liver diagnostics, kidney evaluations and arterial assessments."



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— Chris Schlenger, CEO of Verdure Imaging

Another key advantage is that it eliminates radiation exposure, presenting a safer diagnostic solution. This benefit has attracted interest from Children's National Hospital in Washington, D.C.

"We conducted research at the hospital related to scoliosis-diagnosed cases, monitoring children that potentially were going to require surgery," Schlenger said. "The hospital is interested in future collaborations from a wellness perspective. Scoliosis cases that are nearing the threshold for surgery require regular imaging, which increases the risk of cancer, especially in children. Minimizing patient risk is their priority. So the big use case we see is for screening because there is no harm."

In October 2024, Schlenger received FDA clearance for SpineUS to analyze spinal alignment, opening new opportunities in chiropractic care and physical therapy.