Solution Brief

NerveTrack™
Real-Time AI-Based Technology for Nerve Detection

Samsung Collaborates with Intel to Speed Nerve Detection and Improve Workflows

Real-time AI inference of ultrasound nerve images powered by the Intel® Distribution of OpenVINO™ toolkit helps enhance workflow and improve accuracy for anesthesiologists

SAMSUNG MEDISON

"To keep up with the changing world of healthcare, you need trusted partners and flexible technologies. That's why we teamed up with Intel to create our NerveTrack™ solution. With our combined industry expertise and cutting-edge solutions, we're using AI-based technologies to help practitioners identify nerves faster and more accurately. The result is potentially less risk, better patient outcomes and more-efficient workflows."

—Dr. Won-Chul Bang, VP, responsible for Product Strategy in Samsung Medison

The demand for ultrasound-guided regional anesthesia (UGRA) is on the rise, partly fueled by the increased availability of high-resolution ultrasound machines.[1] UGRA helps anesthesiologists visualize their target structures, facilitating accurate injection of local anesthesia around the nerves. Research shows that one of the most common mistakes made during ultrasound-guided procedures is "advancing the needle without seeing the needle tip properly."[2] This is closely related to another difficult task that anesthesiologists can encounter during UGRA procedures: identification of nerves. Previously, anesthesiologists needed extensive experience to properly identify nerve regions in ultrasound images. Now, Samsung Medison has developed a real-time automatic nerve tracking feature called NerveTrack™ to help novice—and expert—practitioners.

NerveTrack™ uses the Intel Distribution of OpenVINO toolkit to improve performance of real-time AI inference models that detect and identify the location of a nerve area during ultrasound scanning, helping to improve the treatment workflow of URGA practitioners. Developed using a significant amount of clinical ultrasound data, NerveTrack™ has shown real potential to help anesthesiologists find nerves more quickly and accurately, opening a new range of possibilities in medicine.

Benefits of Samsung Medison's NerveTrack™ automatic nerve tracking feature include:

- **More accurate nerve detection:** Not only does NerveTrack™ search for the nerve itself, but it recognizes the landmarks surrounding the nerve to improve detection accuracy. Using the Intel Distribution of OpenVINO toolkit's CVAT (Computer Vision Annotation Tool), Samsung could increase the size of the image data set for training the NerveTrack™ feature by 7x, leading to improved accuracy of more than 20 percent.[3]
- **Faster image processing and smoother workflows:** One of the benefits of medical ultrasound imaging is the ability for users to interact dynamically with real-time data. The Intel® Core™ i3 processor and the Intel Distribution of OpenVINO toolkit can accelerate ultrasound image processing while simultaneously performing nerve detection. By identifying nerves in real time during ultrasonography, practitioners can minimize the possibility of complications while improving workflows.

OpenVINO™

See backup for performance configurations. Results may vary.

Challenge: Detecting hard-to-find nerves

Because nerves are so small, their images may be affected by speckle noise—or signals from other targets—and artifacts (images that appear on an ultrasound but aren't really there). In addition, some nerves and their adjacent tendon structures are hard to identify in an ultrasound, while others don't have landmarks that distinguish them. Scanning angle and pressure also make nerves hard to find in ultrasound images.

Research also shows that peripheral nerves are particularly challenging to work with: "Peripheral nerves provide unique challenges as an injection target, including borders that can be somewhat indistinct relative to surrounding tissue. Nerves also are relatively mobile and have the potential to move from the initial target site with tissue movement as well as infiltrating injectate. Nerves are also vulnerable targets with considerable potential for injury."[4]

Solution: Real-time AI inference for more-accurate nerve detection

Expert anesthesiologists scanned various nerve ultrasound images and drew the ground truth (GT) of anatomical structures that could be landmarks around nerve regions. They checked and corrected every frame to ensure that the GT rectangle completely covered the nerve region. This data was used to improve the accuracy of automatically detecting nerves in ultrasound images.

Using the Intel Distribution of OpenVINO toolkit, inference accelerated by 9x with NerveTrack™ running on an Intel Core i3 processor.[3] A key discovery was that this workload could be handled on existing hardware by utilizing the unused performance headroom of the integrated GPU. This allowed Samsung Medison to run NerveTrack™ simultaneously with image processing of the ultrasound system and will enable the deployment of this capability across their full ultrasound portfolio. This result was achieved through close collaboration between Intel and Samsung Medison software engineers.

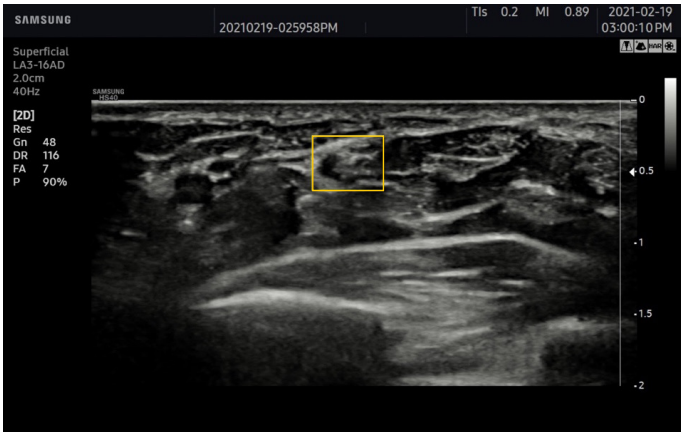

Figure 2. Nerve location automatically detected by NerveTrack™

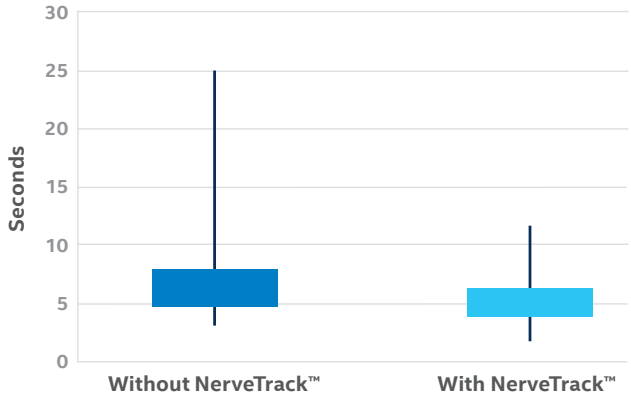

Figure 1. Box plot of nerve detection time by physician with or without NerveTrack™. In an example case, NerveTrack™ reduced scanning time significantly, from 24.7 sec to 8.2 sec.[3]

Evaluation: Comparing nerve detection time

To determine differences in efficiency of nerve detection time, Samsung Medison compared and evaluated the time it took for a physician to detect a nerve with and without NerveTrack™. When evaluated on a 5-point scale, the average score without NerveTrack™ was 3.8 points, and 4.4 with NerveTrack™. Since the p-value is less than 0.0001, it can be said to be statistically different with 95 percent confidence. Comparing nerve detection time, the p-value of the time reduction is statistically significant as 0.0086, so NerveTrack™ is shown to improve the efficiency of nerve detection time.

How it works

In this example, an ultrasound is performed on a patient's wrist. The yellow box on the screen in figure 2 shows the location of the nerve automatically detected by NerveTrack™. The location is tracked whenever the clinician moves the probe.

According to Professor Jee Youn Moon MD, PhD, Seoul National University Hospital, "NerveTrack™ can detect the median and ulnar nerve with reasonable accuracy over almost the entire range of the forearm. It can shorten inspection time, immediately finding the nerves in real time—even if the doctor does not trace from the wrist to the proximal direction. In particular, it can detect the ulnar nerve even at a level where landmarks such as the ulnar artery are not adjacent. These capabilities could help safe needle procedure by allowing the nerves to be separated from the surrounding tissues and vessels."

NerveTrack™ also shows significant stability and robust performance in terms of shape variations. In the case of shape and appearance changes, it can still track the region. If nerves disappear and reappear, NerveTrack™ shows potential to be able to "track back" onto a nerve that was removed from the plane of view and then appears again.

Learn more

Samsung Medison has attracted global attention in the medical field with its R&D capabilities and advanced technologies. Visit **samsunghealthcare.com** to learn about Samsung's various and advanced ultrasound features.

Find out more about the Intel Distribution of OpenVINO toolkit and how it may help accelerate your workloads by visiting **intel.com/openvino**.

For more information about healthcare and life sciences technology solutions powered by Intel, visit **intel.com/healthcare**.

About Samsung Medison

Samsung Medison, an affiliate of Samsung Electronics, is a global medical equipment company founded in 1985. With a mission to bring health and well-being to people's lives, the company manufactures diagnostic ultrasound systems around the world across various medical fields.

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1. "Ultrasound-Guided Regional Anesthesia Market Size to Reach USD 420.2 Million by 2028,"Emergen Research, February 9, 2021.
2. Scholten, H.J., et. al., "Improving needle tip identification during ultrasound-guided procedures in anaesthetic practice," Anaesthesia, 2017.
3. Performance claim based on internal Samsung testing as of March 2021. System configuration: Intel® Core™ i3-8100H CPU @ 3.0GHz, 8GB memory, OS: 64-bit Windows 10.
4. Strakowski, Jeffrey, MD, "Ultrasound-Guided Peripheral Nerve Procedures," Physical Medicine and Rehabilitation Clinics of North America, Volume 27, Issue 3, August 2016, Pages 687-715.