

With a new app, smart devices can use GPS underwater

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A team at the University of Washington has developed the first underwater 3D-positioning app for smart devices, such as the smartwatch pictured here. Credit: University of Washington

Even for scuba and snorkeling enthusiasts, the plunge into open water can be dislocating. Divers frequently swim with limited visibility, which can become a safety hazard for teams trying to find each other in an emergency. Yet even though many dive with smartwatches designed to

go to depths of more than 100 feet, accurately locating mobile devices underwater has confounded researchers.

Now, a team at the University of Washington has developed the first underwater 3D-positioning app for [smart devices](#). When at least three [divers](#) are within about 98 feet (30 meters) of each other, their devices' existing speakers and microphones contact each other, and the app tracks each user's location relative to the leader.

This range can extend with more divers, if each is within 98 feet of another diver. The team will present its findings in September at the [SIGCOMM 2023 conference](#) in New York City.

"Mobile devices today can work nearly anywhere on Earth. You can be in a [forest](#) or on a plane and still get [internet connectivity](#)," said lead author Tuochao Chen, a UW doctoral student in the Paul G. Allen School of Computer Science & Engineering. "But the one place where we still hadn't made mobile devices work was underwater. It's kind of the final frontier."

Above water, GPS relies on a vast satellite network to locate [mobile devices](#) with [radio signals](#). Underwater, these signals quickly fade. Sound, though, travels faster and farther in water than it does in air. Previous underwater positioning systems have relied on strategically placed buoys, but these systems are expensive and cumbersome to deploy, leading many divers to do without.

The UW team found that such buoys aren't necessary. With the app, if the dive leader has at least one other diver visible, the group's devices can send acoustic signals to each other through their microphones and speakers and use the timestamps to estimate each diver's distance. Based on these distances, the app can estimate the group's formation and each diver's location. If a device also tracks depth, as sport monitors like the

Apple Watch Ultra or the Garmin Descent do, the system can locate divers in 3D.

The app needs at least three devices in its network to function, and its accuracy improves as more devices are added. When tested with four to five devices in local lakes and a pool, the app estimated locations with an average error of about 5 feet (1.6 meters)—close enough for divers to see each other in most environments. To get actual GPS coordinates, instead of tracking locations relative to the dive leader, the leader needs to be wirelessly connected to a surface device on a boat with GPS capabilities.

The study builds on [a previous breakthrough](#) from the lab called AquaApp, which allows divers to send messages to each other underwater.

"This and AquaApp can be used together," said author Justin Chan, a UW doctoral student in the Allen School. "For example, if the dive leader finds someone going the wrong way, the leader can send an alert: 'Hey, you're going out of range. You need to come back.' Or if a diver is running out of oxygen, an SOS can let the team find the person quickly even in murky water."

More information: Tuocho Chen et al, [Underwater 3D positioning on smart devices](#). DOI: 10.1145/3603269.3604851

Provided by University of Washington

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