New INL gunsight technology should improve accuracy for target shooters, hunters, soldiers

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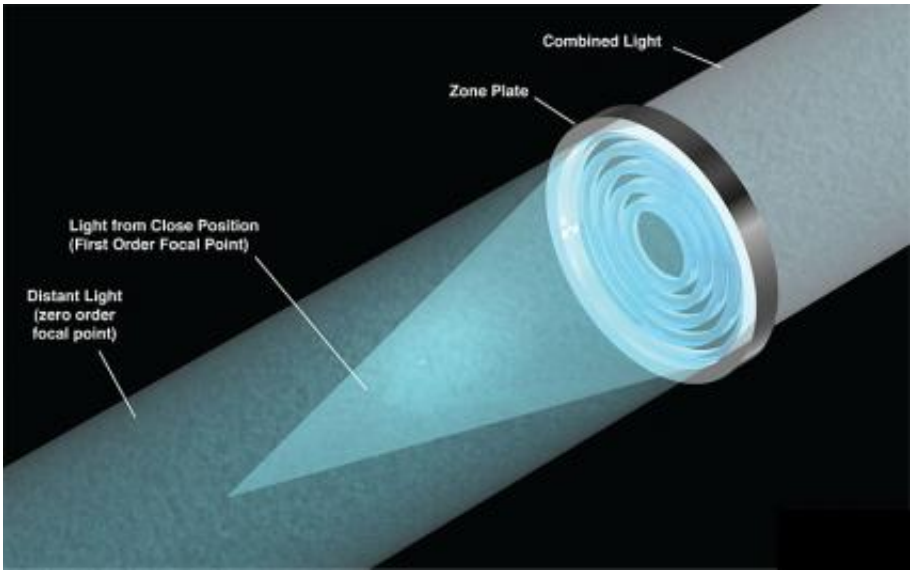
The MicroSight's wafer-thin optical element is only about a quarter-inch in diameter.

Go down to the rifle range and fire a few rounds at a target 100 meters out. Chances are you won't hit the bull's-eye. Even if you read the wind right and don't twitch as you're squeezing the trigger, you may well fall at the first hurdle: lining up the shot.

Aiming a weapon is harder than it looks. Shooters need clear views of a distant object (the target) and a near one (the iron sight at the end of the rifle barrel) at the same time. But the eye can't quite pull this off, as a simple experiment shows: Point at a faraway house or storefront, then try to bring both your finger and the building into focus. One or the other will be blurry.

Idaho National Laboratory's innovative gunsight technology, the MicroSight, helps the eye solve this problem. The MicroSight, a disc smaller than a dime, brings both the target and the iron sight into simultaneous focus, giving marksmen a better sight picture. The new sight has national-security applications, as it could improve safety and performance for American soldiers. Millions of target shooters and hunters should also benefit.

"The MicroSight gives you much of the performance you'd get out of a holographic or telescopic sight," says INL engineer David Crandall, who developed the technology. "But it's more reliable, much lighter-weight and much cheaper."



The alternating rings on zone plates bring faraway and nearby objects into focus simultaneously.

The magic of zone plates

Crandall is not an optics specialist. Most of his past work tended toward infrastructure engineering, like nuclear projects with INL's Advanced Test Reactor. But Crandall is a highly accomplished target shooter — he's a member of the U.S. national long-range rifle team — and he's come up with several other shooting-related inventions. He patented a rifle-stabilizing shooting sling, for example, and a small, powerful breaching shotgun that could help law-enforcement personnel storm buildings more safely and effectively.

One day, Crandall was leafing through an optics textbook, and he stumbled across a section on "zone plates." Zone plates are optical devices that resemble lenses. But whereas lenses focus light using refraction — essentially, changing the direction of light waves by changing their speed — zone plates use diffraction. Diffraction describes how waves bend, break up, spread out and interfere with each other as they encounter obstacles. The diffraction of sound waves, for example, explains how you can hear someone's voice from around a corner.

Zone plates focus light via a set of concentric rings that alternate between transparent and opaque. The transparent sections let some light waves pass through unchanged, focusing objects that are far away (basically, at infinity). But light passing the edges of the opaque rings gets diffracted, which brings nearby objects into focus. The seemingly impossible result: sharp images of distant and near objects, simultaneously.

Zone plates aren't new. Frenchman Augustin-Jean Fresnel worked out their underlying scientific principles in the early 1800s. But it took Crandall, with his shooter's eye, to recognize the potential zone plates held for improving gunsights.

"Competitive shooters are always looking for an edge, for something

better," Crandall says. "You have to, when you're going against the best in the world."

Crandall took his idea to INL's technology transfer division, which also saw the promise and agreed to fund his research. He eventually found his way to phased zone plates. Phased zone plates replace the opaque rings with transparent glass of varying thickness. This accomplishes the same goal — diffraction — but does so without losing as much light, yielding brighter images. After much tinkering, Crandall came up with the MicroSight.

INL engineer David Crandall, a highly accomplished target shooter, uses the MicroSight to take aim at a target 100 meters away.

A smaller, cheaper, more robust sight

Without help from zone plates, the human eye cannot focus on two different planes at the same time. So shooters using only standard-issue iron sights see either a blurry target or a blurry sight. Their performance can suffer as a result, sometimes with tragic consequences. Every year, Americans die after being accidentally shot by hunters who fail to properly identify their target.

The MicroSight isn't the only gunsight technology that can overcome this problem, of course. Telescopic sights magnify targets, bringing them into close, crisp focus. And holographic sights project a red dot onto an image of the target, showing clearly where the shot will land.

But telescopic and holographic sights have their drawbacks. For one thing, they tend to be bulky. Both types of sight can add one or two pounds to the weight of a rifle — not a trivial concern for hunters or soldiers who must lug their weapons for miles over rough terrain. Further, both are complex instruments with fragile components. They can break, especially if dropped or banged against a rock or tree. Red-dot sights require batteries, which can die. And neither one is cheap: most red-dot sights cost more than $100, and high-quality telescopic ones can run $1,000 or more.

The MicroSight, on the other hand, is tiny — its zone plate is thin and only about a quarter-inch in diameter — and relatively cheap. Crandall says the sight should cost significantly less than red-dot and telescopic sights when Apollo Optical Systems, which licensed the technology, takes it to market. The company is currently working with gunsight manufacturers to design and develop various MicroSight versions. In the future, some of these versions might add refractive power to the zone plate, achieving some level of target magnification.

The MicroSight could improve the accuracy of serious target shooters, who cannot use telescopic or holographic sights in competitions. The technology could aid hunters and soldiers, too, either as a primary aiming reference or as a lightweight, inexpensive backup for other types of sights.

Crandall foresees other possible applications as well, such as in handguns and night-vision goggles. In any situation that requires taking the long and the short view at the same time, this new INL technology could

provide a clear edge.

Provided by Idaho National Laboratory