Inside This Issue

Hypersonic hybrid

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Aiming for the *stars*

A California firm plans to offer hypersonic testing-as-a-service with a space gun stars

In his 1865 novel, *De la Terre à la Lune*, Jules Verne imagined a giant gun designed to launch humans to the moon. A century and a half later, a California startup, Longshot Space, is adapting its own space guns to serve as hypersonic launchers – and is aiming to provide high-frequency hypersonic testing-as-a-service.

Longshot was founded during the 2020 Covid pandemic by Mike Grace, a former molecular biologist at NASA's Ames Research Center. He had read about a large cannon called the V-3, developed by Germany during World War II, which used multiple blank-round charges to accelerate long-range projectiles to high supersonic speeds. Grace wanted to see if he could make a giant potato cannon using the basic V-3 design.

With help from friend and Longshot co-founder Nathan Saichek, a manufacturing engineer with rocket maker Astra, he successfully built the launcher in his garage in San Jose. It used 6in-diameter PVC pipe and multiple gas injection. According to Longshot's vice president of defense, Mark Bigham, it fired a projectile at over Mach 1.

The success led Grace and Saichek to establish Longshot Space. Bigham says they started with answering the question: "'What is the absolute cheapest and fastest way we can put stuff into space?' They thought that if they basically built a giant potato gun that was totally reusable, they could reduce space launch cost and increase launch cadence."

UNDER PRESSURE

Grace and Saichek had essentially built a distributed injection ballistic launcher. In the late 1980s, a trio of researchers led by Harold Gilreath, a propulsion engineer at Johns Hopkins University's Applied Physics Laboratory, authored a paper on affordable access to space and long-range artillery, describing the potential and challenges of distributed injection ballistic launchers.

Distributed gas injection was developed to increase the speed at which a projectile can be fired. Standard guns and artillery employ a detonated gas mixture to push a projectile down a barrel from behind. But there's a speed limit, often described as two-times the speed of sound of the working fluid (gas) in a vacuum. Going faster – up to and beyond hypersonic speeds, generally Mach 5-plus – requires a different approach.

In simple terms, distributed gas injection sees a pressurized gas injected behind a projectile at successive points along the launch tube in which a near vacuum has been created, accelerating the projectile with each injection. Vacuum is typically maintained by a membrane-like burst-disc at the muzzle end of the launcher. The projectile pierces the disc on its way out to free-flight.

Very high projectile speeds can be achieved with distributed gas injection. Researchers like Gilreath realized these could be increased even further by shaping the rear of a projectile like a boat tail. The shape effectively makes a projectile moving down a launcher at Mach 5 appear as if it is receding at Mach 1, allowing progressive injection to impart further thrust, pushing it to hypersonic velocities theoretically up to Mach 38.

Longshot's accelerators lie flat on the surface rather than standing on a pad, which is what keeps the civil engineering cheap »

"There's a need and demand for affordable high-cadence hyper-