Less Wriggle Room

Calling his invention a ball worm, a mechanical engineering professor at Baltimore's Johns Hopkins University has coupled a low-friction ball screw to a speed-reducing worm gear. The result is a precision, high-ratio gearbox so low in friction that in many cases it can be back-driven—an impossible feat for everyday worm drives.

The impetus for the project came from needle-sticking robots that accompany patients in CT scanners. Such robots can deliver precisely guided shots into the heart of a tumor by working from the coordinates of a reconstructed 3-D scan. Needle-sticking robots can deliver drugs with precision that is unmatched by human touch. They also spare doctors radiation exposure.

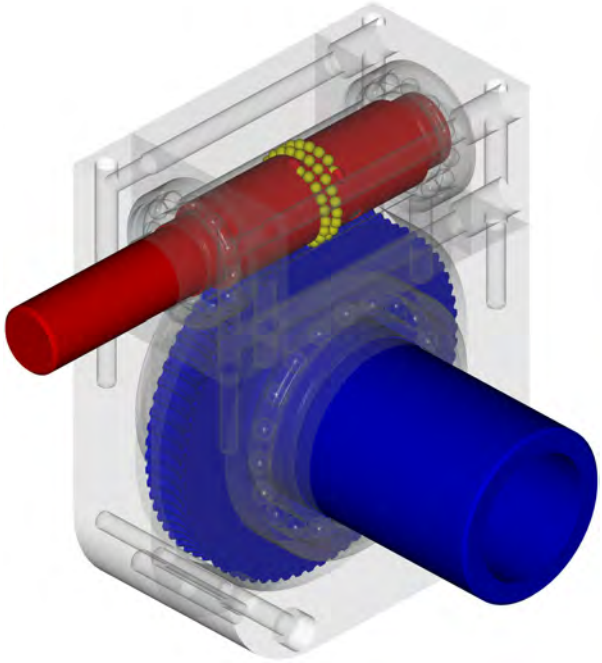
The professor, Dan Stoianovici, and coinventor Louis Kavoussi needed the precision of linear ball screws for rotary motion in the needle-handling robot arms. Each arm uses two ball worms, Stoianovici said. He expects other applications to surface for the new device.

A computer numerical control machine, for example, typically uses linear ball screws for three axes while relying on an ordinary worm gear to drive a fourth-axis rotary table. Stoianovici thinks that a ball worm could turn the rotary table with better precision and lower backlash.

Backlash in a worm gear is reduced by adjusting the distance between axes—not by too much, though, or friction rises enormously. Backlash in the new ball worm can be lessened without causing a big jump in friction. The new device also wears better than conventional worm drives, because elements roll rather than slide by each other.

In leafing through patents that date from as far back as the early 1900s, Stoianovici found about 30 that made similar claims to that of his invention. "None had been built and none were commercially available," he said. He attributed this only to the recent catching-up of design and manufacturing technologies that can handle the calculations and machining needed for the device's complicated geometry.

To make the balls rolls correctly, for instance, a manufacturer has to machine a tooth profile that widens as it moves from the center of the gear face to the outer edges. Someone also has to create the thread from two distinct circular profiles, he said.



Balls serve the same function in this worm that they do in screws: negate friction and slop. Modern tools make it possible to build an old concept.

DAN STOIANOVICI