

# PRECISION, LOW PROFILE GEAR SYSTEM

Dr. Yuan Zheng of The Ohio State University invented the circular wave drive (CWD), a compact and co-axial gear head that allows for speed reduction in rotational motions. CWD was originally developed as a replacement for traditional harmonic gears, commonly used in robotic applications. The CWD design offers many advantages over traditional harmonic gears, most notably are increased torque capacity and lifespan.

The CWD was patented by OSU and licensed to a startup company to commercialize. However, the design had not been reduced to practice. The company contracted CDME to translate Dr. Zheng's revolutionary concept from an idea to a commercially viable product. The commercialization process was underpinned by a gated process that started with an additive manufactured prototyped unit, design optimization and ultimately functional prototypes that could be used to market the technology and conduct basic testing for benchmarking against traditional harmonic and RV robotic gears.

CDME is currently seeking additional industrial partners to further develop the commercial potential of this technology.

## THE TECHNOLOGY

The original design of the circular wave drive, as envisioned, held great promise due to the incredible design simplicity, strength, few parts, and potential for high reduction ratios. CDME's design improvements kept these initial advantages and expanded on them, adding increased parts strength, an even higher and wider range of reduction ratios, lower backlash, and further ease of manufacturing. The current, fully developed design of the CWD allows for simple modular design, a range of reduction ratios from 10:1 to 1,000:1, very low and easily controllable backlash, and simple construction leading to streamlined design and increased durability.

As a result of function, circular wave drive has many advantages over both the competitive RV series gears and the harmonic drive gears. It is capable of extreme high reduction ratio, very low backlash, high torque loads and rugged design all housed in an efficient and cost effective unit. This allows for a large number of applications in both extremes of industrial gear reduction markets. Its high degree of design variability also allows for a wide range of intermediate applications. These qualities provide access to a very large industrial market. Given the research and the reduction to practice of the gearing system, a relatively small amount of additional investment is required to create a scalable production ready system with patent protection.



Prototypes of CWD Gears for Precision and Industrial Applications

## INVENTORS

Dr. Yuan Zheng is a Professor of Electrical and Computer Engineering and the Winbigger Designated Chair. He developed the seminal intellectual property and resultant patent for the technology while trying to improve the performance and longevity of humanoid robots. His research garnered him the interest of President Ronald Reagan, who gave Yuan the Presidential Young Investigator Award.

Jake Martin and Nate Ames, employees of CDME, worked in collaboration with Yuan to improve upon the design of the gearing system design resulting in the filing of a second patent. CDME's model is built around strong student involvement on projects. At the time of his involvement, Jake was a senior at OSU working toward a B.S. in Engineering. As an intern at CDME he provided insight into the development of a novel mechanical interface, which is embodied in the patent.

## PROJECT LEAD

Nate Ames received his B.S. and M.S. in Welding Engineering from Ohio State. He spent 5 years as a New Product Development engineer for Swagelok Company and 11 years at EWI where he led several departments. In 2002, Nate started his first company. In 2012 he helped launch an oil and gas services company to support the shale gas plays in Pennsylvania, West Virginia and Ohio. In 2015, he returned to OSU to help launch CDME.



## KEY FEATURES AND BENEFITS

- High degree of design variability
- Wide arrange of applications
- High torque loads
- Capable of extreme high reduction ratio
- Very low and easily controllable backlash
- Compact size
- Solid steel instead of flexible alloy leads to a longer life cycle and low cost in materials and fabrication.

## MARKET OPPORTUNITIES

- By 2018, global gear demand is expected to grow to \$217 billion USD.
- By 2018 it is projected that 1.3 million new industrial robots will be installed in factories around the world.
- Industrial automation is expected to have a steady growth of 15% annually into 2018.

## THE OHIO STATE UNIVERSITY

CDME is supporting the commercialization of technologies that emerge from Ohio State's annual research efforts. Ohio State has one of the largest research and development budgets of all universities. The amount of annual funding is a leading indicator of the breakthrough innovation occurring within the University. Recent annual highlights from OSU:

- » \$934 Million: Total research and development (R&D) expenditures
- » \$470 Million: Federal R&D expenditures
- » \$101 Million: Industry-sponsored research expenditures

Whether your interest is in licensing, sponsored research, joint ventures, investment, corporate giving or placement of our best students, Ohio State is here to help accelerate your business through innovation.

### Intellectual Property

US Patent 20150345607A1 • Pending • "Circular Wave Drive"  
 US Patent 2015/062728 • Pending • "Circular Wave Drive for High Ratio Reduction of Rotational Drive Motors"

### Categories

Mechanical Engineering,

### College

College of Engineering (COE)  
 Department of Electrical and Computer Engineering

## CONTACTS

### CDME

1314 Kinnear Road, Columbus OH, 43212  
[cdme.osu.edu](http://cdme.osu.edu)

Nate Ames, Project Lead  
 ames.21@osu.edu • 614-292-6570

Eric Wagner, Collaboration Manager  
 wagner.293@osu.edu • 614-477-0303

### Technology Commercialization Office

Jason "Jay" Dahlman, Licensing Manager  
 dahlman.3@osu.edu • 614-292-7945