“Cold Atom Gyros”

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Cold atom gyroscopes have been demonstrated to have extremely low angle random walk and excellent long-term stability. As a result, these sensors are an enabling technology for many demanding applications in inertial navigation and precision pointing. Cold atom gyros based on light-pulse atom interferometry share a common technological foundation with accelerometers, gravimeters, gradiometers, and atomic clocks. By tailoring design parameters, cold atom gyros can satisfy performance and environmental requirements for a wide range of platforms. Ultimately, cold atom gyros should become ubiquitous for precision inertial sensing just as atomic clocks have for precision timekeeping, with similar reliability and longevity. AOSense has built several generations of these sensors, and is continuing to drive the technology toward increasingly compact and robust sensors for applications in the field. This tutorial will provide an overview of atom interferometry, operating principles of cold atom gyros, and applications.

Dr. Todd Gustavson is Director of Advanced Sensor Development at AOSense, Inc. Since joining AOSense in 2006, he has actively participated in designing multiple generations of sensors for cold atom gyroscopes, accelerometers, and gravity gradiometers. As a research scientist at Stanford working with Prof. Mark Kasevich from 2003 to 2006, he designed and implemented the software architecture for timing, control, and data acquisition systems for atom interferometers, and was the principal designer of a compact gravity gradiometer. From 2001-2002, he was employed at Finisar Corporation, where he developed methods to optimize compact diode laser systems for stable operation over a wide temperature range, and was an inventor on 3 US patents. As a postdoc working with Nobel laureate Wolfgang Ketterle at MIT (1999-2001), he helped design and build a novel apparatus to demonstrate the first continuous source of Bose Einstein condensed atoms. He received MS and Ph.D. degrees in physics from Stanford University in 1997 and 2000, respectively. His Ph.D. thesis *“Precision Rotation Sensing Using Atom Interferometry”* under the direction of Prof. Mark Kasevich demonstrated an atom interferometer gyroscope with angle random walk 2×10^{-6} deg/h$^{1/2}$. During his graduate studies, he was an exchange scholar at Yale University from 1997-1999. He received a BS in Physics from Caltech in 1993.