Deep Integration of Thin Flexible Autonomous Microsystems for Vision Correction

C. H. Mastrangelo, H. Kim
and R. M. Walker
University of Utah,
Salt Lake City, ECE Department
carlos.mastrangelo@utah.edu

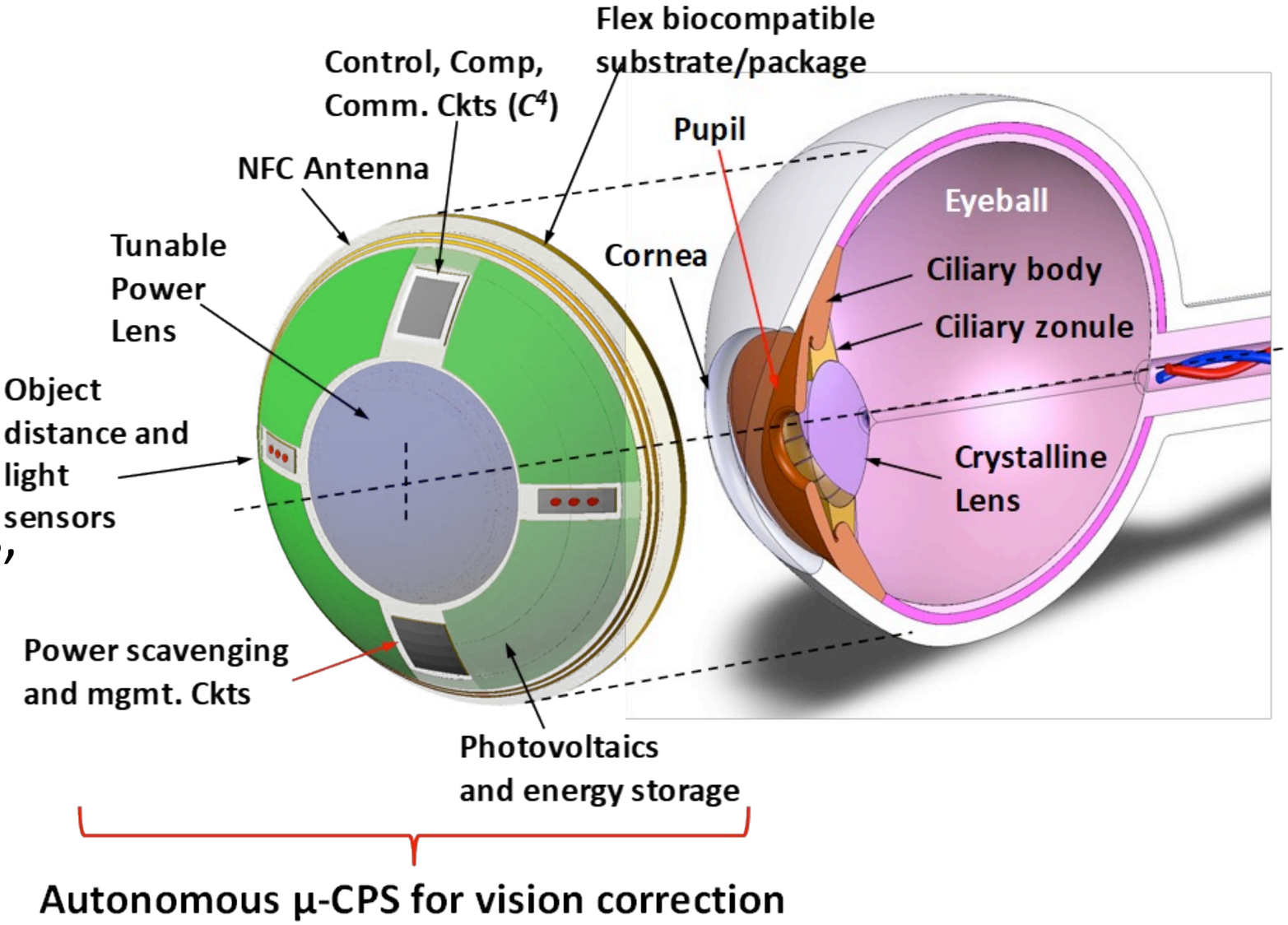
CNS-1932602

μ-CPS Description

Autonomous Medical μ-Systems for Active Vision Restoration can benefit 1.7B people affected by **presbyopia, or loss of vision accommodation**

Project Goals

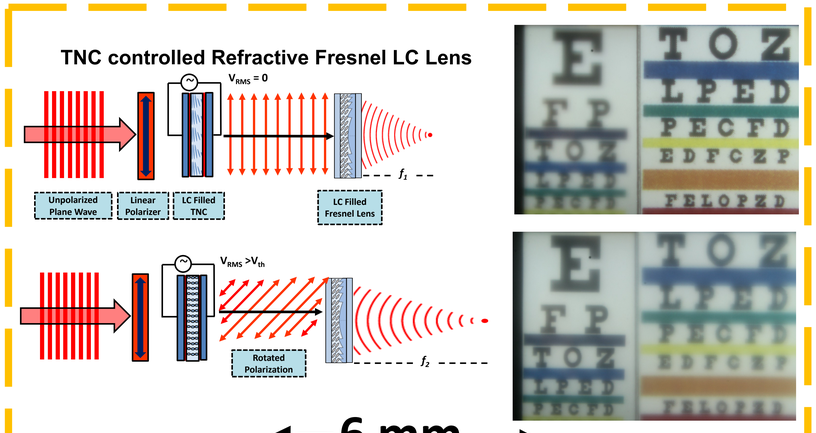
- Development of thin, electrically tunable contact lenses and vision correction algorithms.
- Implementation of thin, autonomous energy scavenging, communications, computing and sensing microsystems.
- Inhomogeneous technology integration on flexible bio-compatible substrates

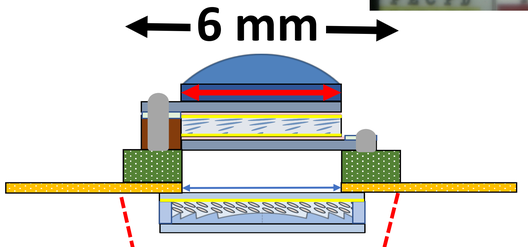


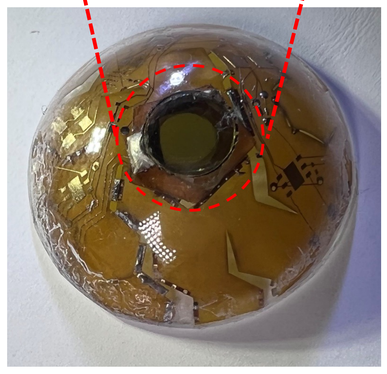
2021 Research Results

- Developed imaging grade 2-µW Twisted Nematic Cell -based varifocal liquid crystal lens
- Developed nano-Watt magnetic-based object range finder
- Developed eyelid motion Mg-Air battery + solar cells Integrated power pack > 100 μW sustained
- Developed low-power PWM algorithms for controlling tunable lens

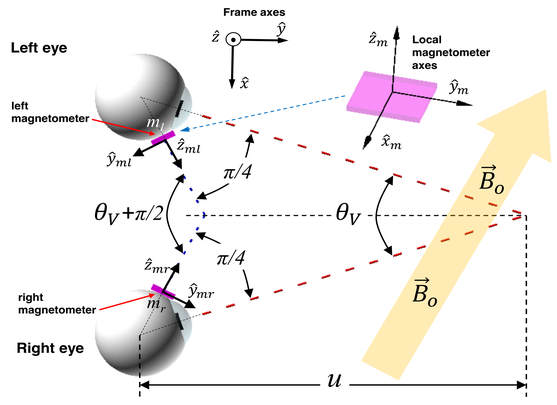
New imaging grade (2021) ~2 µW TNC+Fresnel LC lenses

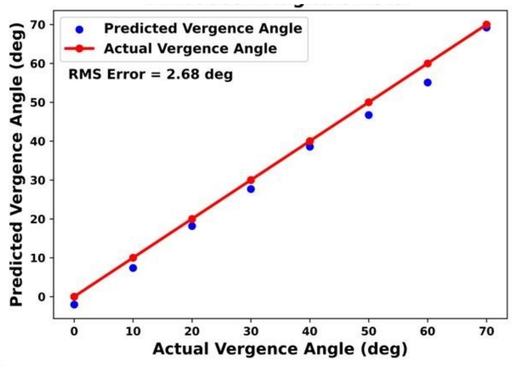






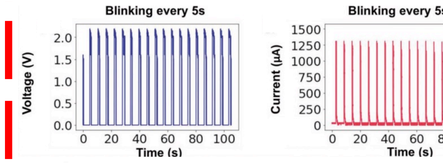
Nano-Watt magnetic-based Vergence object distance sensor

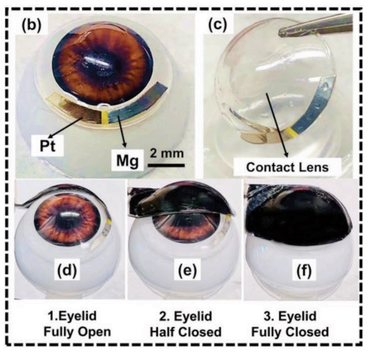


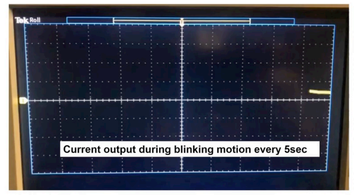


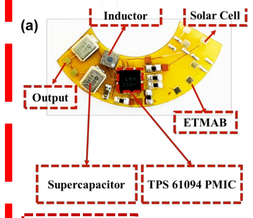
- Method only requires measurement of external vector field quantity
- No emission of radiation
- Extremely low power in analog domain
- Power consumption determined by magnetometer chip circuits

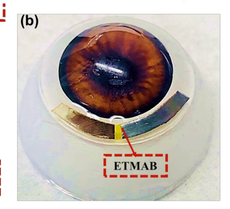
Metal-air + Solar cell > 100 µW Power pack

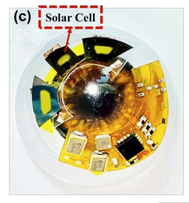


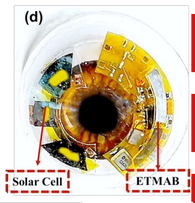






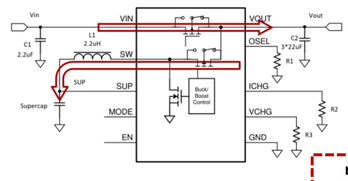


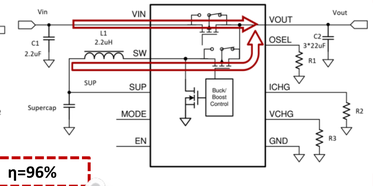




Storage Unit

4.6 µAh





η=96%

Power Generators	Power Management IC	Delivered Voltage	Delivered Power
Solar Cell (Indoor) + ETMAB	NOT Connected	At 1.5 V	113 µW
Solar Cell (Outdoor) + ETMAB	NOT Connected	At 1.5 V	2.7 mW
Solar Cell (Indoor) + ETMAB	Connected (TPS 61094)	DC Stable 3.3 V	109 µW
Solar Cell (Outdoor) + ETMAB	Connected (TPS 61094)	DC Stable 3.3 V	2.6 mW