Optron Systems, Inc.

Advanced Optical MEMS Devices and Systems

Introduction

Optron Systems is a small R&D firm with expertise in advanced optics, optical devices, and optical and micro-electromechanical systems fabrication. Our business goal is to be a key source of novel optical components and devices for system integrators and product developers. With a business focus on R&D of innovative optical components, our efforts will enable ongoing developments in 3-D and near-eye displays, virtual reality, machine vision, adaptive optics, specialty video projectors (visible and infrared), and other high-value emerging optics applications.

In particular, our current focus is the development of a line of high-resolution membrane mirror based micro-electromechanical (MEMS) spatial light modulators (SLMs). The initial demand-driven application for these devices employs them as the core of a low-cost infrared scene projector for thermal imaging system testing. They have a range of applications that include light field optics for 3-D and near-eye displays, adaptive optics, dynamically adjustable gratings and mirrors, and advanced video projection systems.

Optron is actively seeking statements of interest, product development collaborations, and investment from potential end users, value-added integrators, and strategic partners, for both our current technology and for our new R&D efforts in 3-D displays.

Our Innovative Technology

Optron's technology platform consists of innovations at several levels within its advanced optics and optical MEMS development program. Our work ranges from custom silicon chips with 2-D electrode arrays that drive our micro-optical devices, to fully functional prototype opto-electronic modulators and systems.

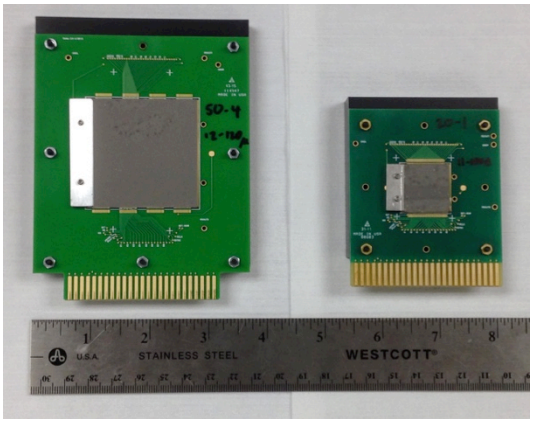
Infrared Video and Scene Projector

Captured MWIR test pattern from our IRSP

Developed as a "first proof-of-concept" application of our underlying membrane-mirror-on-VLSI technology, Optron's infrared scene projector (IRSP) supports hardware-in-the-loop testing of thermal imaging systems and focal plane arrays. Our projector supports multi-spectral use, from sources that may be monochromatic or broadband thermal black-body, and of any polarization. The system offers true analog flicker-free grayscale operation, and generates minimal on-chip heat by using an off-chip infrared source. The projector can also be adapted for use with visible and ultraviolet light.

Membrane Mirror Spatial Light Modulator

The novel device at the core of our scene projector is our membrane mirror light modulator (MMLM), a phase-only spatial light modulator based on a highly deformable micro-mirror, currently with resolutions up to 1 mega-pixel. It is capable of operating at video frame rates, insensitive to polarization, and operable across a wide spectral range from infrared to ultraviolet. Such modulators have a range of applications in advanced optical systems, which we are continuing to explore. Device details are available in a separate white paper.[1]



Membrane mirror SLMs mounted on interface cards

High Voltage VLSI MEMS driver chips

Our MEMS modulators are built atop a custom high voltage (HV) VLSI actuator array chip capable of 20 V output. They are currently available in two sizes: 20 mm square arrays of 1000x1000 20 µm pixels; and large-format 46 mm square arrays of 768x768 60 µm pixels. The chip provides direct analog rastered access to pixel capacitors in 16-channel parallel banks. Larger format driver chips up to 140 mm diagonal can be commissioned.

Programmable Digital Video MEMS Interface

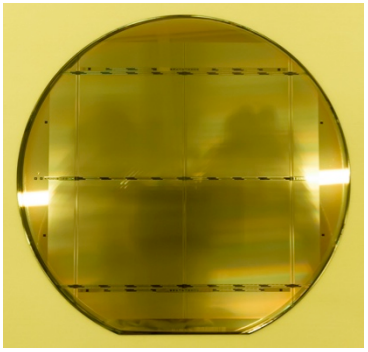
Our HV-VLSI driver chips are controlled by a fully programmable FPGA-based digital video interface, enabling flexible digital video post-processing and timing. It incorporates a high-bandwidth parallel 16-channel x 16-bit DAC/amplifier unit with adjustable high-voltage levels. Video can be generated by internal FPGA circuitry, by the included single-board computer, or by an external HDMI source.

Capabilities

While many small R&D shops are innovating in system design using existing components, Optron's focus is its

[1] optronsystems.com/pubs/Optron-IRSP-TechBrief.pdf

ability to develop the novel underlying optical devices that enable advanced optical systems. In order to develop novel microfabricated device prototypes with greatly reduced facilities overhead costs, we leverage access to shared cleanroom facilities and advanced microfabrication tools made available by world-class research institutions, including members of the NSF National Nanotechnology Infrastructure Network. We operate as a "fabless" VLSI chip laboratory by collaborating with outside chip and PCB foundries. Thus, we can focus in-house equipment investments purely on the specialty work which cannot be done elsewhere.



150 mm wafer containing four of our 46 mm large-format MEMS driver chips

The key expertise of Optron's research staff is in optics, optical systems, and microscale device design and fabrication with a MEMS focus. Additional competencies of our staff, regular consultants, and partners include: digital and analog circuit design and manufacturing, VLSI microchip design and manufacturing, machining and prototyping, and software development. Our focus is on core device R&D rather than volume manufacturing, but we are also prepared to demonstrate full prototype systems as required to support testing or proof-of-concept demonstrations.

Future Research Directions

At Optron, we believe that our initial proof-of-concept technology is just the start. In addition to ongoing performance improvements to our existing devices, we are planning an aggressive program of forward-looking research, building on our core expertise in micro-optical devices. Selected future research thrusts include:

New applications of our current technology platform

- Flicker-free, non-polarizing displays and scene projectors for high-speed imaging applications.
- High-resolution adaptive aberration correction for astronomy, ophthalmology, and machine vision.
- Dynamically reconfigurable, non-polarizing optical elements such as gratings, mirrors, and beam shapers.

Microfabrication R&D enabling new devices

- New modular fabrication and assembly techniques for rapid development of future MEMS-on-VLSI devices.
- Next-generation high-voltage MEMS actuator chips.

Novel device and system R&D for high-impact markets

- Miniature near-eye display systems.
- 3-D light field and holographic display systems.

Investment and Partnerships

Optron has received multiple Small Business Innovation Research (SBIR) Phase II contracts from the DoD to seed the development of our technology to a pre-production stage with a modest budget. We have received interest from potential customers in our infrared scene projector, and are currently under contract to deliver a prototype unit to the U.S. Air Force.

We are actively seeking **statements of interest** in our work. We are pursuing a two-pronged business strategy, using maturation of our current technology as a stepping stone to our future high-impact research and development goals aimed at the 3-D display market.

Current technology maturation and integration

In order to bring our scene projector product from research prototype to full manufacturability, we are seeking **value-added system integrators and commercialization experts to partner with us.** Our goal is a mutually beneficial partnership that leverages partner commercialization expertise to complement Optron's strength in core device R&D, in order to deliver commercial-grade turnkey systems to customers and vendors.

New research and innovation initiatives

In addition to maturing our existing work, we are soliciting **long-term investment partners for our new, high-impact R&D programs aimed at the 3-D display market.** As discussed above, Optron's R&D expertise will be applied to a program of optical device, system, and microfabrication process research, with a focus on developing novel next-generation optical components that will enable emerging 3-D display markets.

Company Background

Optron Systems is a Boston-area small business with a long history of innovation in advanced optics, optical devices, and optoelectronics. Founded by Dr. Cardinal Warde, a professor of electrical engineering at M.I.T., the company previously developed liquid crystal on silicon (LCoS)-based micro-displays, and in 2002 spun off Radiant Images, Inc. to commercialize this technology.

Following this successful venture, Optron returned to a startup-sized footprint to focus on new innovations in MEMS-based optical devices, developing a high-speed optical shutter product, the precursor to its current modulator. Since then, it has focused on developing the current technology platform discussed herein.

Contact Us

General Inquiries: **info@optronsystems.com**
Investor Relations: **invest@optronsystems.com**
235 Bear Hill Rd Ste 200, Waltham MA 02451-1060, USA
Tel: +1-781-890-3600 Fax: +1-781-275-3106
www.optronsystems.com