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**PRESS RELEASE**
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## Mirrorcle Technologies concludes successful SPIE Photonics West 2022

The world leading manufacturer of MEMS-based optical beam-steering products and system solutions, Mirrorcle Technologies, announces the successful completion of the first live, in-person, Photonics West after the cancellation of the 2021 show. Finally, SPIE was held again at the Moscone Center in San Francisco, attracting more than 3200 technical attendees and almost 3000 exhibition visitors from around the world. Mirrorcle' presence, in addition to exhibiting its products on the show floor, included the presentation of an academic paper on recent developments surrounding the company's patented gimbal-less MEMS mirrors and how they will enable robotics solutions, as well as the sponsorship of the Best Paper Awards for the *MOEMS and Miniaturized Systems XXI* conference. Also, Dr. Milanovic's volunteered chairing of a number of sessions at the conference, as some of the originally scheduled chairpersons were unable to attend the event in person.

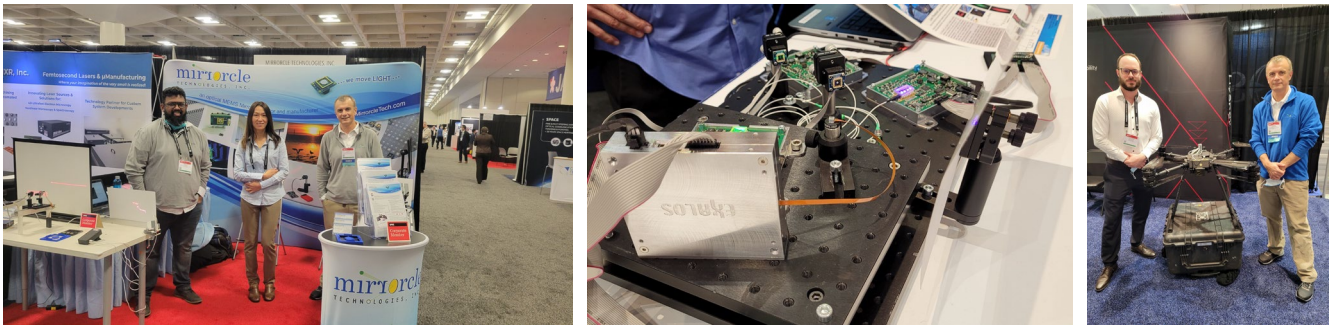

*Figure 1. At Photonics West 2022, Mirrorcle continues to offer MEMS Mirror Modules and subsystems, and adds System solutions for 3D Perception Sensing (SyMPL 3D LiDAR) and Visual Messaging (RGB Playzer). There were products and demonstrations with Mirrorcle MEMS at various booths on the exhibition floor, as well as new contacts made in the robotics and drone industries to help integrate the Lidar and Playzer technologies into their applications.*

## Technical Team presents MEMS-based human-robot interaction solutions

The company's commitment to the photonics technical community both academically and commercially was reaffirmed in the technical conference sessions that accompanied the leading photonics event in the world. Mirrorcle's team contributed to the technical conference program with a presentation titled "Optical MEMS enable next generation solutions for robot vision and human-robot interaction" which was presented on January 24th, 2022, as part of the MOEMS and Miniaturized Systems XXI Conference. The company's Software Engineer, Daniel Lovell, elaborated on the latest developments, drawing a large and engaging audience who filled the seating and standing space of the conference room. The presentation outlined

how MEMS-mirror-based sensing and projection solutions can reduce operation costs, improve efficiency, safety and flexibility of autonomous robots and drones. Acknowledging that increasing automation and independently operating smart machines serve a critical role in Industry 4.0 and the Transportation Revolution, the deployment of such systems in modern work environments necessitates seamless human-robot interaction such as obstacle avoidance and intent communication to facilitate a safe and pleasant coexistence of human and non-human ‘colleagues’. The presentation revealed how MEMS mirrors-based sensing and interaction systems designed for robots and drones offer novel solutions with the lowest power consumption, weight, and cost in high volume production. For example, Mirrorcle’s recently developed 3D perception sensing solution (SyMPL 3D Lidar) and animated visual messaging solution (Vector Graphics Laser Projection system named Playzer) is optimized for robot and drone applications are ready-to-use and easy to implement. “These sub systems each consume <1.5W in power, which is at least 10x lower than other solutions in the market – they weigh less than 50 grams in OEM versions, and have small form factors,” explained Mr. Lovell. “Furthermore, we can show that the fusion of these two systems leads to new capabilities and functionalities that meet the growing demand of both robot vision as well as human-robot interaction.” After his well-received talk, Mr. Lovell invited attendees to the booth #4105 at the Photonics West show floor, which featured a number of additional demos and systems demonstrating the unique capabilities of Mirrorcle’s products.


*Figure 2. Mirrorcle’s Daniel Lovell enjoys discussions with visitors following his presentation on MEMS Mirror-based Industry 4.0 system solutions at the MOEMS and Miniaturized Systems XXI Conference 2022.*

**Mirrorcle continues world leadership with booth loaded with MEMS Mirror Solutions**

The Mirrorcle booth #4105 featured some of the company’s established products such as a Standard Development Kits alongside MEMS Mirror Modules, as well as some of the latest demos and solutions that were freshly revealed to visitors for the first time. Not always visible are the continual improvements in designs, including MEMS mirrors as well as driver and controller electronics which were displayed at the Mirrorcle booth in a variety of eye-catching demos. The company’s extended API offers multiple Linux platforms and a number of optional software add-ons such as solutions in Python. One of the new and exciting demos was the company’s internal reliability test station which had been used internally in a variety of longevity and reliability studies for select volume customers. Up to ten individual dual-axis MEMS mirrors are driven simultaneously with a 1000/1050Hz quasi-static Lissajous pattern. The setup was designed to obtain a maximum number of cycles per hour for customer-requested 1000 hour / 3billion cycle testing. The demo at the Mirrorcle booth is the actual

reliability test station that had been temporarily moved from the company’s lab to the booth for the 3 days of the show. A Playzer vector graphics laser projector serially illuminates each of the devices under test so that operators can visually verify functionality of all devices at any time. “Showing this ongoing reliability test at the exhibition booth demonstrates our confidence that the devices will perform as expected,” said Sr. Electronics Engineer Abhishek Kasturi. “The five devices that we have shown at the show have already been running for 1000 hours. One should stress that our products do not show any hysteresis over time and we are frankly not sure about any upper limit to lifetime of our MEMS mirrors.

Visitors of the Mirrorcle booth could also witness a single-axis resonant device generating a sinusoidally swept line with a full optical angle of 60° with no optical enhancement (it is a +-15° mechanical tilt MEMS Mirror of 2mm diameter running at 3.4kHz or 6800 lines/s). The intention was to illustrate some of the large-angle capabilities of Mirrorcle products – and for single-axis resonators it’s even higher than for dual-axis devices running in quasi-static mode. Another exhibit was a miniature robot featured two monochrome Playzer units to demonstrate human-machine communication as well as a MEMS-mirror based 3D lidar system. The mid-range Lidar is dubbed “SyMPL” which stands for ‘Synchronized MEMS Pair Lidar’ is designed for environmental sensing and obstacle / collision avoidance Finally, MTI Also had on display  the compact full color vector graphics laser projection (VGLP) system “RGB Playzer”. “We are excited about the opportunity to present our latest system-level solutions here at Photonics West,” said Mirrorcle’s CEO, Dr. Milanovic. “We are glad to have emerged from the pandemic stronger than ever before and have been blessed with exponentially growing demand for our world-class leading MEMS mirrors and related hardware and system solutions. We appreciate the support and trust that our customers place in our technologies and believe it will further aid us by tapping into rapidly growing market segments.”

**Company in unprecedented ramp-up despite global supply chain challenges**

Commenting on whether the community of optical system solutions developers and academics need to have any concerns regarding the global supply-chain challenges and shortages in semiconductor industry, Dr. Milanovic explained: “We are uniquely able to provide world-leading MEMS mirrors and related hardware and accessories from low quantity orders up to thousands of devices per month and beyond. Our lead times and pricing have been very consistent throughout this challenging period and our customers have certainly been able to rely on our team while focusing on many other challenges of their own. Thanks to a significant uptick in demand, we have been shipping substantially more than ever before, and we are well-positioned to serve the global photonics market - big and small players from multiple industries.” In 2022, Mirrorcle Technologies is expected to ship as many of its products as in the company’s 17 year history combined. Assuming the continuing trajectory of demand, the current year may be seen as just a warm-up for what is projected for 2023 and beyond. “We would like to expressly thank our capable vendors and contract manufacturers for making possible a smooth transition from our in-house, low volume manufacturing from a few years ago to the high-volume and high-quality production that we have established to date. In light of the increase in demand and further ramp-up of capabilities, we welcome inquiries from interested vendors who believe that their services may suit our imminent and projected needs,” Dr. Milanovic said. “We are actively looking at additional automation equipment, personnel, and capable suppliers – there is no secret there.”

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**About Mirrorcle Technologies, Inc.**

Mirrorcle Technologies, Inc., founded in 2005, is a private corporation that commercially provides products and laser systems based on its proprietary optical microelectromechanical system (MEMS) technology. Since its founding, and supported by its continuous investment in R&D, the company has been offering the world's fastest point-to-point (quasi-static) two-axis beam-steering MEMS Mirrors, as well as resonant-type micromirror devices with video rates. Mirrorcle is globally the only provider of tip-tilt MEMS actuators in combination with mirrors from submillimeter to several mm in diameter, offering customers a wide selection of specifications to optimize their paths to successful commercialization. Mirrorcle products can be found today in 3D metrology systems, biomedical imaging systems, solid-state LiDARs, AR/VR prototypes, laser projectors, and classrooms. Mirrorcle’s system solutions include the world’s most compact vector graphics laser projectors and 3D LiDARs.
Mirrorcle maintains multiple cleanroom laboratories at its Richmond, California headquarters, and year-round, 24-7 access to a wafer-based CMOS and MEMS fabrication facility. Beyond its own facilities, the company has established high-volume manufacturing with leading MEMS wafer foundries and qualified opto-mechanical assembly houses.

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