



About OML

The Optical Microsystems Laboratory (OML) was established at Koç University in 2002 by Prof. Hakan Ürey. The research is focused on applying microoptical and microelectromechanical systems to develop novel devices and systems. The laboratory has particular expertise in 3D displays, Pico-projectors, MEMS laser scanners, MEMS spectrometers, MEMS imaging, and MEMS based bio-sensing.

The research group currently has 23 researchers including post docs, engineers and graduate students. The group has a large and well-equipped laboratory for constructing optical, mechanical, and electrical characterization setups as well as a cleanroom dedicated for characterization of sensitive components.

The laboratory has participated in five FP6 and FP7 projects and has extensive experience in industry cooperation. Noteworthy are the collaborations with Microvison Inc., USA on the development of MEMS scanners and novel architectures for pico-projectors and with Aselsan Inc., Turkey on the development of MEMS based thermal imaging cameras. In 2013 Prof. Ürey was granted the prestigious ERC advance grant for “Wearable augmented reality 3D displays”.

Website:

<http://mems.ku.edu.tr>

Twitter:

http://twitter.com/koc_oml



Optical Microsystems Laboratory in 2014

As we are approaching the end of the year, it is time to review OML's total “output” in 2014. Here you can find a summary.

A Productive Year of Projects

Throughout 2014 six different projects have been conducted simultaneously. OML is going to start running two new projects approved by TÜBİTAK (Dynamic Range and Sensitivity Enhancement for Mems Based Thermo-Mechanical IR Detector with Optical Readout) and ASELSAN (3-D Stereoscopic and Autostereoscopic Screen Module Development Project). Finally, OML has completed two other projects funded by OPET and ASELSAN.

OML spin-off Kuantag Inc. has now five employees and aiming to have its first sensor product for automotive industry in 2015. Another spin-off activity Tarabios Inc. is continuing to develop a reader and cartridge to serve the home-care diagnostics market. Another spin-off activity is planned in the area of wearable devices and displays.

Prolific Publishing Activity

In 2014 OML members published 8 journal papers. Another journal paper

is still in review. In addition to 3 invited and 5 plenary talks, OML members presented papers on 6 conferences. As for the patents, OML has applied for eight new patents and one of the previous patents was issued.

New and Leaving Members

Thanks to the ERC Project, OML team has grown significantly. After the recruitment of Erdem Ulusoy (post-doc), Muhsin Eralp (Res. Asst. Prof.), Gökhan Sağlam (Project Manager), Gülistan Eren (Admin. Asst.), Seyedmahdi Kazempourradi (PhD), Mehmet Serhan Can (PhD), Fariba Ghaderinezhad (PhD) we are now a team of 22 members.

But throughout the past year we have also lost some of our valuable members. Kaan Akşit finished his dissertation and now he is a post-doctoral researcher at Nvidia Research. Necmettin Kılınç has a position at the department of mechatronics engineering at Niğde University as an assistant professor. Erhan Emek will work with Assistant Professor Kerem Pekkan for another ERC Project. İbrahim Mahçiçek, Osman Eldeş, Aref Mostafazadeh, and Shadi Khan Baloch have left the nest as well. All of them will be missed.

UPDATE ON TWO RECENTLY COMPLETED PROJECTS: Development of Uncooled Infrared (IR) Detector with Optical Readout (sponsor ASELSAN)

Ulaş Adıyan

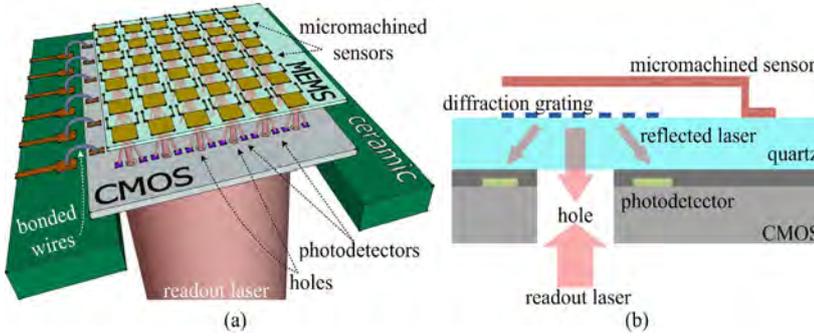


Figure 1: a) Integrated Sensor Array b) Side View of a Single Sensor

Thermal imaging has been a useful tool in many thermal mapping applications such as medical imaging, target detection, surveillance, monitoring circuits and rescue. In 2006, 1st Phase of the ASELSAN project, The Fabrication and Development Of MEMS Based Uncooled IR Detectors, was started in Koc University OML (Optical Microsystems Laboratory) and it was completed successfully in 2010. In the scope of 2nd Phase of the Aselsan project which was started in 2011, the design, fabrication and characterization of micro electro-mechanical system (MEMS) based uncooled thermo-mechanical infrared (IR) sensor arrays integrated with CMOS based optical readout are carried out. Pixelated sensor array operation is based on the conversion of incident IR radiation to

mechanical displacement. Sensor arrays are designed and microfabricated in 640x480, 320x240 and 64x64 pixel formats with 35 μm sensor pitch using standard MEMS processes with SixNy/Al and Parylene/Al material combinations. Optical readout IC is fabricated using standard 0.18 μm CMOS process. As a post-process, the CMOS chips are thinned and through wafer holes are etched, which allow the readout laser beam to pass through. After the CMOS post-process steps, MEMS and CMOS dies are aligned and integrated, which enabled a novel integrated optical readout. The tests of the MEMS sensors and the integrated sensor array were successfully performed. In May 2014, the final meeting of the project was held and the 2nd Phase of the project was completed.

Acknowledgement: This project was started in 2004 and included substantial contributions from OML team members Hamdi Torun, Onur Ferhanoğlu, Fatih Toy, Burak Erarslan, Selim Ölcer, Fehmi Çivitci, and Ulaş Adıyan; our collaborators at EPFL (Prof. Yusuf Leblebici's group) and METU-MEMS (Prof. Tayfun Akin's group); and many engineers from our sponsor Aselsan.

Functionalization of MEMS cantilever with nanostructures for bio-chemical sensor application (sponsor TUBITAK)

Necmettin Kılıç

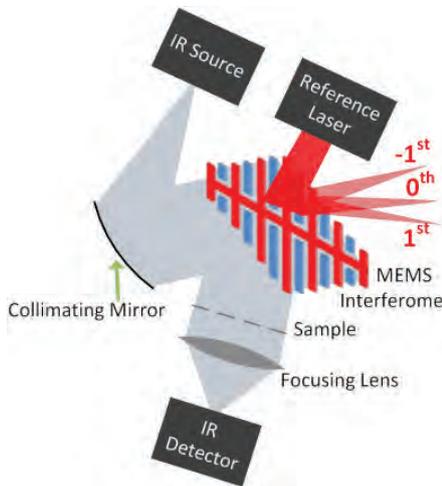
Collaboration between OML (Optical Microsystem Laboratory), Koç University and NNAG (Nanosensor and Nanodevice Research Group), Gebze Institute of Technology started with TUBITAK postdoctoral research fellowship project that is entitled "development of MEMS cantilever for precision measurements". In the scope of this project, cantilevers were fabricated by using different magnetic materials and gas sensor application of one-dimensional nano-metal oxide materials coated cantilevers was investigated. Gas sensors have been widely researched due to high application area such as industry (oil-chemical, mining, cosmetics-perfume, automotive, food, etc.), health, agriculture,

environment, defense and security. In general, the gas sensors consist of three main units that are analyte, sensitive materials and transducer.

OML and NNAG jointly proposed a two-year joint COST projects and it was accepted (2014-2016, project number: 113F403). The aim of this project is to produce one-dimensional metal oxide / polymer hybrid structures for gas sensor applications. In order to fabricate gas sensor devices, 1D metal oxide / polymer hybrid structures will be coated on different transducers such as interdigital transducer, cantilever and quartz crystal microbalance and then these sensors will be tested for volatile organic compound (VOC) gases.

For A Truly Portable FTIR Spectrometer with Sub-Second Measure Times

Sven Holmström



Overview of the core function of the LGI Spectrometer.



Mounted MEMS Interferometer.

MEMFIS was a successful 2.85 million Euro European Union FP7-program that lasted between 2008 and 2012, aiming to develop the world's smallest Fourier transform spectrometer. OML was the only university partner in the seven partner consortium. Fourier transform infrared (FTIR) spectroscopy has been the gold standard for IR spectroscopy for a variety of applications, such as chemical analysis of solids, fluids, gases, and process flows. Current FTIR spectrometers, however, are costly bench top laboratory instruments with measurement times of several seconds to minutes. The vision of MEMFIS was a truly portable FTIR spectrometer with sub-second measurement times. Such a device has the potential to open up new research directions and applications.

The approach of the project was to work simultaneously on two different solutions for the MEMS-based interferometer, which is at the core of the spectrometer. While Fraunhofer IPMS (Dresden, Germany) designed a miniature moving mirror for the traditional Michelson configuration, Koç headed the work on a solution using a lamellar grating interferometer (LGI). This work is based on a patent by Prof. Hakan Ürey and former PhD student Çağlar Ataman, granted in 2013. LGI is a dynamic diffraction grating operated at resonance that enables the FTIR spectrometer to be simpler, more robust, and to be operated at standard pressure.

The Second Koç University



On October 24, the “Project Brokerage Event” organized by the Research and Project Development Directorate and Technology Transfer Office (APGTTD) took place. OML participated to the event with its posters about Display Technologies and Non-invasive Milk Deterioration Detection Technique Based on Laser.

Koç University Summer



As part of Koç University Summer Research Program three high school students, Şule Kahraman from Robert College, Berk Toy and Onur Karaçoz from Kabataş Erkek Lisesi, participated in an OML research project. During the approximately five week long program, Şule Kahraman and Berk Toy produced a computer controlled microscope sample holder. To produce the sample holder they made use of old CD Room pieces and game console joysticks.

ONGOING RESEARCH and SPONSORS



European Research Council,
WEAR 3D
2014-2019



Scientific and
Technological
Research Council
of Turkey
114E882 (2015)
111E183 (2012-
2015)
113E184 (2012-
2014)
113S074 (2013-
2016)



ASELSAN
2015-2017



CURRENT OML MEMBERS



DIRECTOR

Prof. Dr. Hakan Ürey

RESEARCHERS

Dr. Fehmi Çivitçi

Dr. Muhsin Eralp

Erhan Ermeç

Dr. Emre Heves

Sven T. Holmstrom

Selim Ölçer

Gökhan Sağlam

Dr. Erdem Ulusoy

PhD STUDENTS

Ulaş Adıyan

Uğur Aygün

Mehmet Serhan Can

Onur Çakmak

Fariba Ghaderinezhad

Mehmet Kıvanç Hedili

Mahdi Kazempour

Shoaib Rehman

Soomro

ADMIN. ASST.

Gülistan Eren

M.Sc. STUDENTS

Başarbatu Can

Osman Eldeş

Hazal Er

Deniz Mengü

Amir Hossein

Ghanbari Niaki

Yusuf Samet Yaraş

UNDERGRAD. ASST.

Ekin Akyürek

Göksu Kara

Celalettin Yurdakul

Group Events of the OML



May 2014

Karting and Dinner in İstinye

On May 6 OML members organized another group activity in İstinye. After an exciting and amusing five round karting activity, the crew had a dinner at a Wrap House.

OML Bike Ride

On September 19, OML members organized a cycling tour from Koç University to Kilyos over Rumelifeneri. 15 members participated in the tour. When we arrived at Kilyos at noon, some went swimming. Afterwards the other OML members who did not participate to the tour joined the activity. After the lunch the group cycled to Koç University, this time over Zekeriyaköy. Total distance traveled was more than 50 km.



September 2014