MECHANICAL ENGINEERING SEMINAR

Monday, April 11 2022 at 14:30, Betty and Dan Khan Building, Auditorium 1.

Fluidic Shaping of Optical Components on Earth and in Space

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Fabrication of optical components has not changed significantly in the past century, and is based on mechanical grinding, machining and polishing that rely on complex and expensive infrastructure. Modern manufacturing methods such as 3-D printing, while capable of producing nearly arbitrary structures, cannot provide the required surface quality for optical applications.

I will present our theoretical and experimental work on leveraging the basic physics of liquid-fluid interfaces for fabrication of a wide range of high-quality optical components, without the need for any mechanical processing.

I will first discuss the use of light projection as a mechanism to induce temperature gradients on a thin liquid film, resulting in its spatial deformation by the thermocapillary effect. Based on an inverse problem solution, we can predict the illumination pattern required in order to create a desired deformation. Polymerization of the film results in diffractive optical elements, with sub-nanometric surface quality.

To create larger components such as eyeglasses or telescope lenses, the elimination of gravity is crucial. We turned to experimenting with neutral buoyancy and developed a passive method wherein we engineer boundary conditions on fluidic interfaces to drive liquid volumes into minimum energy states that correspond to desired optical topographies. Time permitting, I will discuss our collaboration with NASA on the use of this technology of in-space fabrication of optics and for the creation of large space telescopes that overcomes launch constraints.

Moran Bercovici is an Associate Professor of Mechanical Engineering at Technion – Israel Institute of Technology. He is equally interested in understanding basic physical mechanisms related to fluid mechanics and in leveraging them to create new tools and technologies across different disciplines. Moran earned his BSc and MSc from the Faculty of Aerospace Engineering at Technion, and holds a PhD in Aeronautics and Astronautics from Stanford University. He worked as postdoctoral fellow at Stanford School of Medicine, and was a Harrington Faculty Fellow at the University of Texas at Austin. He received the Krill Prize by the Wolf Foundation, the ERC Starter and Consolidator Grants, and the Blavatnik Award for Young Scientists in Israel.

Seminars Coordinator: Assoc. Prof. Matthew Suss.