MECHANICAL ENGINEERING SEMINAR

Monday, July 1 2024 at 14:30, D. Dan and Betty Kahn Building , Room 217

Online: http://technion.zoom.us/BestSeminarEver

Atomization in Forensic and High Power Applications

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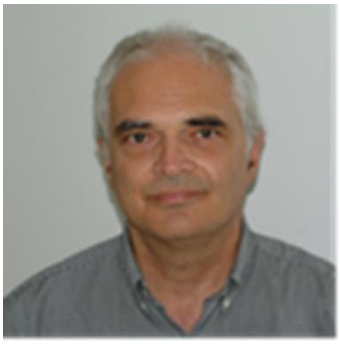
Hosted by: Prof. Eyal Zussman

The talk will cover the following three main topics associated with the acceleration-driven hydrodynamic instabilities and their suppression by elastic forces:
(i) *Atomization in forensic applications.* A theoretical model describing the blood spatter pattern resulting from sharp and blunt bullet gunshots is discussed. These hydrodynamic problems belong to the class of the Wagner penetration problem or the impact hydrodynamics with the pressure impulse generating the blood flow. At the free surface, the latter is directed outward and accelerated toward the surrounding air. As a result, the Rayleigh-Taylor instability of the blood flow occurs, which is responsible for the formation of blood drops of different sizes and initial velocities. Deposition of two-phase blood-drop/air jets onto surfaces is predicted and compared with experimental data. For the short-range shooting an interaction of blood backspatter with muzzle gases becomes important. The vortex ring of muzzle gases moves toward the target and collides with blood drops in the backspatter resulting from the gunshot. This collision turn them backward toward, and even behind, the target, which is confirmed experimentally. (ii) *Reopening dentistry after COVID-19: Complete suppression of aerosolization in dental procedures by viscoelastic Medusa Gorgo.* Ultrasonic cavitron scalers and high-speed dental drills are recognized as the worst aerosolization sources resulting in myriads of tiny droplets of water used as an irrigation fluid. The aerosolization at the cavitron scaler is driven by the Faraday instability, whereas the one at the drill - by the action of the centrifugal force. The resulting airborne droplets entrain saliva and multiple bacteria and viruses from the patient mouth and spread them to significant distances, including open mouths of the other patients in dental clinics, personnel and surrounding surfaces. Similar situations arise in skin surgery, tattoo shops, etc. Droplets below 20 μm in size evaporate before settling down and are a source of airborne viruses (e.g., those of SARS-CoV-2, which are ~100 nm in size). Filtration of such aerosols is highly problematic. However, it is demonstrated here that dilute aqueous FDA-approved polymer solutions being used as the irrigation fluids can completely suppress droplet formation at the generating source without altering flow behavior in the supply line of standard dental chairs. The products resulting from this work are licensed to the industry and enter the market in 2024. (iii) *Liquid films (cavities) subject to pressure difference in the surrounding gas in rheology and large-scale explosions*. Cylindrical films with high gas pressure in the cavity resulting from an exploding electric wire or a chemical explosive are accelerated radially outward and, as is theoretically shown in this work, experience the Rayleigh-Taylor instability, which is confirmed experimentally.

Seminars Coordinator: Assoc. Prof. Shmuel Gal.

BIOGRAPHY



MSc-1977 (in Applied Physics), PhD (in Physics and Mathematics)-1980, DSc (Habilitation, (in Physics and Mathematics)-1989. Affiliations: The Institute for Problems in Mechanics of the Academy of Sciences of the USSR, Moscow (1977-1990); Professor at The Technion-Israel Institute of Technology (1990-2006; Eduard Pestel Chair Professor in Mechanical Engineering at The Technion in 1999-2006); Distinguished Professor at The University of Illinois at Chicago, USA (2006-present); Fellow of the American Physical Society. Prof. Yarin is the author of 6 books, 12 book chapters, 465 research papers, and 12 patents. Prof. Yarin was the Fellow of the Rashi Foundation, The Israel Academy of Sciences and Humanities, and was awarded The Gutwirth Award, The Hershel Rich Prize, and The Prize for Technological Development for Defense against Terror of the American-Technion Society. He is one of the three co-Editors of 'Springer Handbook of Experimental Fluid Mechanics', 2007, the Associate Editor of the journal "Experiments in Fluids", and the member of the Editorial Advisory Board of 'Physics of Fluids', the Bulletin of the Polish Academy of Sciences, and 'Archives of Mechanics'.

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