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DEPARTMENT OF MECHANICAL ENGINEERING
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**Engineering aspects in cryobiology: From solid mechanics
in cryopreservations to automated planning of cryosurgery**

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2004 Black Engineering

Of the numerous engineering aspects in cryobiology, this presentation focuses on continuum mechanics in cryopreservation and automated planning of cryosurgery, which represent two thrust areas at the Biothermal Technology Laboratory of Carnegie Mellon University.

Continuum mechanics in cryopreservation – Cryopreservation is the preservation of tissues at low temperatures, with applications to transplantation and regenerative medicine. Techniques for successful cryopreservation of small-scale specimens have been developed over the past five decades for several tissue types, while effective cryopreservation techniques for bulky tissues and organs are still at the exploration stage. An alternative approach to cryopreservation—known as vitrification (vitreous in Latin means glassy)—has been developed recently, which is essentially the freezing of a super-cooled liquid by adjusting the chemical composition and cooling rate so that crystallization is avoided. This part of the presentation addresses one of the key factors that hinder the widespread use of recent developments in cryopreservation for large tissue structures, which is fracture formation.

Automated planning of cryosurgery – Cryosurgery is the destruction of undesired biological tissues by freezing. Cryosurgery is performed by localizing an array of cooling probes, in the shape of long hypodermic needles, within the target region. Currently, the process of selecting the cryoprobes' layout for a specific procedure is an art held by the cryosurgeon, based on the surgeon's own experience and rules of thumb. Suboptimal cryoprobe localization may affect the quality and cost of the medical treatment, possibly leading to post-surgery complications. This part of the presentation concerns the development of a software package prototype for automated planning of cryosurgery.

Yoed Rabin, D.Sc.

Dr. Yoed Rabin received his B.Sc. (1989) and M.Sc. (1991) from Ben-Gurion University, Israel, and his D.Sc. (1994) from the Technion – Israel Institute of Technology. Dr. Rabin joined the Department of Human Oncology at the Allegheny University of the Health Sciences, Pittsburgh, PA, in 1994. Between the years of 1997 and 2000 he was a faculty member of the Department of Mechanical Engineering at the Technion. Dr. Rabin joined Carnegie Mellon University in 2000, where he is now holding the position of Professor of Mechanical Engineering. Over the past 17 years, Dr. Rabin's work has been focused on cryosurgery, cryopreservation, hyperthermia, thermal regulation of biological processes, and sensors and instrumentation. He has published more than 145 publications in books, archival journals, and conference proceedings. Dr. Rabin is an Associate Editor of the ASME Journal of Biomechanical Engineering and a board member of Cell Preservation Technology.

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