# ABC Seminar December 25, 2017

**Speaker:** Nir Dgani, Mechanical Engineering
**Title:** Wave-like propulsion robot over flexible surface
**Abstract:** This research analyzes the locomotion of a wave-like robot over highly flexible surfaces. This bio-inspired robot developed in our lab features a minimalistic mechanical design enabling miniaturization and future use as a robotic probe for medical purposes. We first develop a numerical simulation based on a simple compliant model of the surface that captures the mechanics of locomotion and determine the deformations and forces that the surface applies on the robot. Then, based on the simulation results, we constructed an experimental setup composed of a highly flexible porous rubber silicone surface a force sensor, a linear stage setup and a wave-like robot designed to withstand large forces. Award received: Highly Commended Paper of the Industrial Robot Innovation Award for Practical Innovation in the Field of Robotics - CLAWAR 2017, Portugal

**Speaker:** Shir Kashi Information Systems Engineering
**Title:** Smooth leader or sharp follower? Playing the mirror game with a robot
**Abstract:** The increasing number of opportunities for human-robot interactions in various settings, from industry through home use to rehabilitation, creates a need to understand how to best personalize human-robot interactions to fit both the user and the task at hand. In the current experiment, we explored a human-robot collaborative task of joint movement, in the context of an interactive game. Specifically, we set out to test people's preferences when interacting with a robotic arm, playing a leader-follower imitation game (the mirror game). Twenty two young participants played the mirror game with the robotic arm, where one player (person or robot) followed the movements of the other. Each partner (person and robot) was leading part of the time, and following part of the time. When the robotic arm was leading the joint movement, it performed movements that were either sharp or smooth, which participants were later asked to rate. The greatest preference was given to smooth movements. Half of the participants preferred to lead, and half preferred to follow. We found that the movements of the robotic arm primed the subsequent movements performed by the participants. Our results demonstrate individual differences in preferences, and highlight the importance of personalized human-robot interactions. Award received: Best Late Breaking Report Award - HRI 2017, Austria

**Speaker:** Yarden Sharon
**Title:** Quantitative Characterization of Open and Robot-Assisted Needle-Driving Using the One-Sixth Power Law
**Abstract:** Quantitative characterization of surgical movements can improve the quality of patient care by informing the development of new training protocols for surgeons, and the design and control of surgical robots. We present a novel characterization of open and teleoperated suturing movements that is based on principles from computational motor control. We focus on the extensively-studied relationship between the speed of movement and its geometry. In three-dimensional movements, this relationship is defined by the one-sixth power law that relates between the speed, the curvature, and the torsion of movement trajectories. We fitted the parameters of the one-sixth power law to suturing movements of participants with different levels of surgical experience in open (using sensorized forceps) and teleoperated (using the da Vinci Research Kit / da Vinci Surgical System) conditions

from two different datasets. We found that teleoperation significantly affected the parameters of the power law, and that there were large differences between different stages of movement. These results open a new avenue for studying the effect of teleoperation on the spatiotemporal characteristics of the movements of surgeons, and lay the foundation for the development of new algorithms for automatic segmentation of surgical tasks. Award received:  Finalist of Best Poster Paper Award ICRA 2017 (workshop on C4 Surgical Robots), Singapore