Motion Planning in Dynamic Environments

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Dynamic environments represent a wide range of applications where robots need to navigate among static and moving obstacles or other robots. Examples of such applications include navigation through road traffic, navigating through crowds, aircraft flying around busy airports, and ships entering and leaving busy ports. Common to these applications is the need to generate a collision-free trajectory rather than a collision-free path that solves the equivalent static problem.

One technique to solving the collision avoidance problem in dynamic environments is to plan the trajectory in the robot's velocity space. To this end, the obstacles are mapped to their equivalent "velocity obstacles," which represent the set of forbidden velocities that would cause collision between the robot and each obstacle in some future time. This reduces the collision avoidance problem to selecting velocities that do not penetrate any velocity obstacle at any time.

In this talk, the concept of velocity obstacles will be introduced first for obstacles moving along linear trajectories, followed by an extension to general trajectories. The issue of the time horizon used to generate the velocity obstacle will be introduced and its impact on the trajectories obtained will be discussed. In the context of road traffic, the velocity obstacles can be used to warn the driver of imminent collisions and to plan efficient lane change avoidance maneuvers. This concept will be demonstrated for on-line motion planning in very crowded static and dynamic environments.

About Speaker: Professor Shiller is the founder of the Department of Mechanical Engineering and Mechatronics at Ariel University Center and the director of the Paslin Laboratory for Robotics and Autonomous Vehicles. He earned the BA engineering degree from Tel Aviv University, and the MS and Sc.D. degrees from MIT, all in Mechanical Engineering. Before joining the Ariel University Center in 2001, he served fourteen years on the faculty of the Department of Mechanical and Aerospace Engineering at UCLA where he lead the teaching and research activities in Robotics and directed the Laboratory for Robotics and Automation. Professor Shiller's research activities have focused on robot motion planning, dynamics and control, including time-optimal-motion control and obstacle avoidance. His recent work applies these methods to the navigation and trajectory planning of off-road vehicles, planetary rovers, and intelligent road vehicles. Prof. Shiller is the founding chair of the Israeli Robotics Association.