The first ISER 2006 session covered the state of the art in experimental manipulation. The paper topics ranged from design of devices to facilitate manipulation, to algorithms for controlling, planning, and learning for manipulation. The session participation was high which indicates a broad renewed interest by the community to solve the hard platform and algorithmic questions that will fuel progress in robot manipulation.

The first paper entitles “Bayesian Contact State Segmentation for Programming by Human Demonstration in Compliant Motion Tasks” discusses programming by human demonstration and provides solution to the contact formation recognition problem and to the estimation of the geometric parameters in the motion. The approach in the paper uses particle filters to estimate the contact formation and parameters by first using the system model to make the next step prediction, which are then corrected using sensor data from the human demonstration. The experiments show the performance and accuracy of this method in a carefully engineered environment where a cube augmented with sensors to collect ground truth on pose, twist, and contact wrench.

The second paper entitled “Stable Grasp and Manipulation in 3D Space with 2-Soft-Fingered Robot Hands” presented empirical results to demonstrate the advantage of manipulation with soft fingers. Experiments done with two robot fingers augmented with a soft skin show the application of this control scheme to manipulating cube-shaped objects and to opening and closing bottle caps. The key experimental contribution is the demonstration that the presence of the skin does not prevent the device from exerting the required force.

The third paper entitled “Motion Planning for Robotic Knot Tying” presents a novel algorithm for achieving a goal topology of a given deformable linear object. In the first phase of the algorithm a forming sequence is generated, which serves as a qualitative plan for the crossings in the goal topology of the rope. The algorithm then computes the single query probabilistic road map in the rope’s configuration space. Finally, the collision-free motion of the arms is computed. The algorithm was implemented and evaluated using PUMA robot arms.

The fourth paper entitled “Experimental Investigation of Mechanics in Soft-finger grasping and manipulation considers the case of a simple hand with two 1DOF rotation pinching fingers to build an experimental model of the operation. The paper investigates experimentally a parallel distribution model and tangential deformation to the parallel distribution model. The work compares in simulation and experimentally the parallel distribution model with the radially distributed model and concludes that the two fingers can control both the grasping.

The fifth paper entitled “Learning to Grasp Novel Objects using Vision” presents a learning algorithm that is trained with supervisory learning on synthetic images, and then demonstrated on real objects. The supervisory learning algorithm predicts the
grasp as a function of an image. The training set comprises artificial objects with good grasping points. The learning system uses this information to identify grasping regions in new images. The algorithm was tested on common objects such as wine glasses, cups, pens, and mobile phones using a 5 DOF Harmonic Arm with a parallel plate gripper.

Robot manipulation is a growing area in robotics. This ISER session has called attention to the importance of advances in platforms and algorithms. The results presented in this session demonstrate important steps in bringing robot manipulation closer to autonomous manipulation of a wide range of objects in human-populated environments, for everyday tasks.