Student Projects for fall 2013

Short descriptions (more info and references by request)

1. Planning and implementing stable grasps for non-stiff objects by industrial robot ABB IRB140

   The task assumes planning a way the gripper should approach an object of known location, orientation and geometry to grasp and manipulate it without losing the contact with the object. It is required to develop the program in Robot Studio, software interface of the gripper installed on ABB IRB 140, experiment and analyze the performance.

2. Planning and implementing collaborative manipulation work by two industrial robots ABB IRB 140 and 1600

   The task assumes developing a scenario of two manipulators (ABB IRB 140 and IRB 1600) work in synchrony manipulating one common object. When tested in software, the task should be validated in experiment.

3. Planning and control of a gait of the DARPA Robotics Challenge humanoid Atlas

   The model of a humanoid robot Atlas has been deployed for participants of DARPA Robotics Challenge this year for planning its behavior in simulated environment (http://www.theroboticschallenge.org/, Track C). The robot has 29 degrees of freedom and one of its basic capabilities is to walk over the terrain. The task is focused on planning and implementing this functionality on the available platform.

4. Planning and control of grasps and object manipulation for the DARPA Robotics Challenge humanoid Atlas

   The model of a humanoid robot Atlas has been deployed for participants of DARPA Robotics Challenge this year for planning its behavior in simulated environment (http://www.theroboticschallenge.org/, Track C). The robot has 29 degrees of freedom and one of its basic capabilities is to grasp and manipulate objects. The task is focused on planning and implementing this functionality on the available platform.

5. Planning and stabilization of a gait for quadruped robot

   Four-legs walking machine are known to be superior for many operations in versatility, speed, robustness etc compare to bipeds. However, planning their behaviors and analyzing their functional capabilities are required. The task assumes planning, control and analysis of a particular gait of one of such devices built at Ecole Centrale de Nantes.

6. Analysis of stable gaits for compass biped

   Compass biped walker is the simplest in dynamics mechanism that can experience stable walking on a downhill surface in simulation. Analysis of its gait has attracted enormous attention since the device was built and the gait was reconstructed in

experiment. The project is focused on characterization of its properties such as computing estimates for region of attraction, analysis of walking over rough terrain, and robustness to parameters variations

7. Time optimal motion and trajectory planning for industrial robot manipulator ABB IRB 140

   Planning time optimal trajectories for industrial robot manipulators is one of demanding subjects in robotics since even small increase in productivity can generate a substantial profit in production. The task assumes planning time-optimal trajectories for given scenarios robot's work (move TCP along a circle, a square) and validating/analyzing them in experiment.

8. Stabilization of surge dynamics for compressor systems

   The Moore-Greitzer compressor model is an example of nonlinear control system, which stabilization by output remains an open question for decades. The task assumes the review of the literature on the problem and developing feedback design based on the convex optimization and ICQ control design techniques

9. Trajectory planning and control for the (double) Furuta pendulum

   The classical Furuta pendulum consists of a controlled arm rotating in the horizontal and a one-degree of freedom pendulum passively attached to the arm moving in an orthogonal frame to it. Swing-up and stabilization of the Furuta pendulum around its unstable equilibrium was the challenging task for the last decade. The project is focused on the planning swing-up procedure for the extended mechanism, where double pendulum is attached to the arm.

10. Trajectory planning and control for the `Butterfly' robot

    The robot (http://www.dis.uniroma1.it/~labrob/research/butterfly.html) consists of the controlled rotating base of two similar frames that resembles the shape of a butterfly and a ball that can freely move on frames. The task is plan the trajectory of the ball to move along the frames from a cavity to next one, or organize perpetual motion of the ball in one direction

11. Trajectory planning and control for the non-holonomic snake-like robot

    The task is to explore the complexity of trajectory planning for the snake robot example to follow the robot along the path, and to use various representation of the constraints for recovery of the database of feasible motions. Other part is focused on controller design and analysis of dynamics in a vicinity of the pre-planned behaviors.

12. Planning and implementing a ball throwing by the KUKA LWR

    The project is to plan and implement of ball throwing task for an articulated robot to achieve far distant and accurate trajectories in simulation and experiment.