Legged Robotics

HW #1 – DOF & Workspace

Problem 1 – 10 pts.

Consider the radially symmetric hexapod walking robot (HWR) presented in our lectures. The robot has six articulated legs where each leg has three joints. If the robot does not walk i.e. stands in place, all six feet of the robot will be in contact with the ground. In this case, assuming no friction, you can consider the robot as a hexapod manipulator - with six articulated legs - where the contact point between each foot and the ground can be modeled as a spherical/ball joint. Calculate the DOF of the top platform (end-effector).

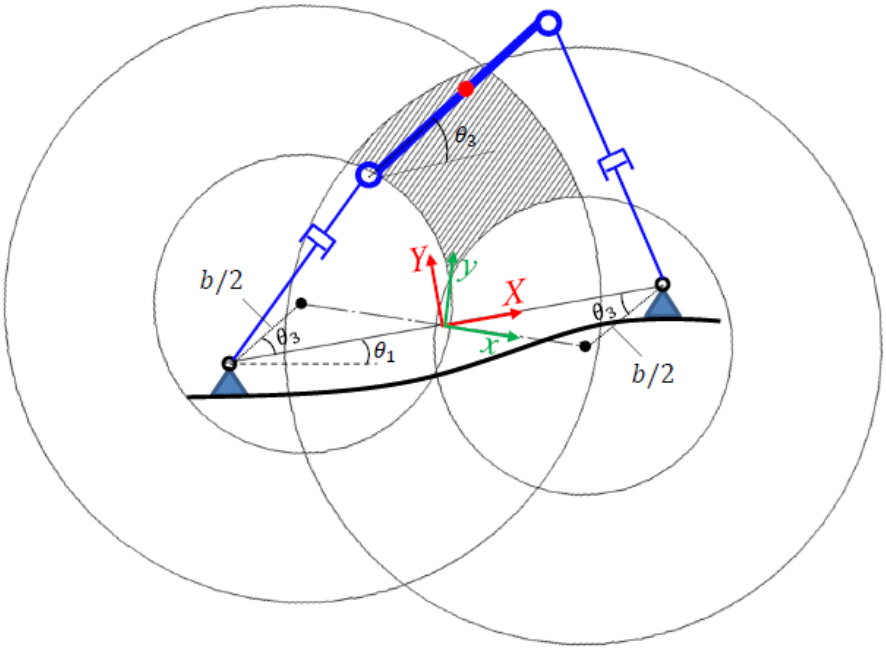
Problem 2 – 60 pts.

Following the concepts learned in the lectures, use a CAD software (or MATLAB) and visually derive/show the 3D COW for Both a Hexapod Stewart-Gough Platform (manipulator) and a Radially Symmetric Hexapod Walking robot when the upper platform is horizontal. You are the designer of the robot, so consider any dimensions and geometry you want for the legs (min and max) and diameters of fixed (lower) and moving (upper) platforms.

Problem 3 – 30 pts.

a) For the planar parallel manipulator shown in the next page, derive the **parametric equations of the boundary curves and points** of the shown workspace (the hatched area) with the **constant orientation** of $\theta 3$ for the robot, all in **X-Y coordinate system** as shown in the figure below. **(Note: The workspace boundary includes four curves and four points. Each curve is part of a circle and each point is created as a result of intersection of two curves).** For simplicity, assume $\theta 1 = \theta 3 = 0$. Consider b as the length of the top platform and d as the distance between two ground contact points. Consider "a" and "c" as the left and right leg lengths, respectively, with the same minimum and maximum extents. If you need to consider the distance between centers of the circles, use the notation D.

b) Consider $lmin = 100$, $lmax = 200$, $b = 300$, $d = 500$, all in millimeters. Calculate the exact workspace boundary of the robot. Show your work.



Good Luck!