Simulation

Our goal is to create a six-legged walking robot simulation in matlab. First of all, we should know how to draw the legs and the body then how we can simulate (animate) it, finally its walking pattern and kinematics.

Kinematics

**Kinematics** is a branch of classical mechanics that describes the motion of points, bodies (objects), and systems of bodies (groups of objects) without considering the mass of each or the forces that caused the motion

Kinematics is split into two types

1 – forward kinematics: determines where the robot hand is (all joint variables are known)

2 – inverse kinematics: to calculate what each joint variable is (If we desire that the hand be located

at a particular point)

Kinematically a robot leg is much like a robot arm, and for this application a three joint serial-link manipulator is sufficient. Determining the Denavit-Hartenberg parameters, even for a simple robot like this,

starting by defining our coordinate frame. along with the robot leg in its zero-angle pose. We have chosen the aerospace coordinate convention which has the *x*-axis forward and the *z*-axis downward, constraining the *y*-axis to point to the right-hand side. The first joint will be hip motion, forward and backward, which is rotation about the *z*-axis. The second joint is hip motion up and down, which is rotation about the *x*-axis, The third joint is knee motion, toward and away from the body, each leg have three links coxa ,femur and tibia ,our body have dimentions also (picture here)

Walking pattern

Tripod gate: is the best-known hexapod gait. A tripod consists of the front-back legs on one side and the middle leg on the opposite side. For each tripod, the legs are lifted, lowered, and moved forwards and backwards in unison. During walking, a hexapod uses its 2 tripods not unlike a bi-ped stepping from one foot to the other - the weight is simply shifted alternately from one tripod to the other. Since 3 legs are on the ground at all times, this gait is both "statically" and "dynamically" stable. The movement scheme is easily visualized by examining the following figure - the numbers adjacent to the legs in the body diagram correspond to timepoints on the graph.

Leg motion

First of all, we need the sequence of motion of the leg be like: lifted, forward then lowered

For the leg we deduce the D-H parameter of each link, putting the dimensions of coxa femur and tibia, then combined them with serial link function in matlab

Animating leg: we can move leg by forward and inverse kinematics giving angles of joint or end point position respectively

Repeat the serial link function for six legs

Body motion

a relation between the legs and center of the body and relations between tool tips is required for easy work. For more declaration when we give position for one tool tip by the relation between tool tips it determine the point of other tool tips by giving the degrees for 18 servos

we have three matlab files for motion of the robot

two functions is

clacHexaBodyIK.m for calculation of hexapod inverse kinematics

calibration.m for reference angles

and the m file for simulation testClacHexaBodyIK .m