Advance Robotics HW-3

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(I)**Algorithm**

1) Calculate the workspace of the robot using forward kinematics equations.
2) Calculate the workspace of the objects.
3) Calculate the final workspace excluding the objects' workspace from the original workspace.
4) Map this workspace in the joint variable space by using inverse kinematics.
5) Create the spline functions for the two joints individually.
6) The spline functions are third order polynomials (acceleration has been considered constant). Velocity at the start and end positions have been considered zero while at the two knot points it is equal since acceleration is constant. Based on these criteria the coefficients of spline functions can be calculated and the final third order joint variable equations can be formed. The total time and the knot points time can be user defined.
7) Form the joint angles equations separately and plot them w.r.t time.
8) Combine these joint variables' plot and plot them in the theta world workspace of the robot calculated from step 3.
9) Find the starting, end and the knot points in the map. The knot points should be selected in such a way so that the points within the object are excluded from the final trajectory. The points can be joined using different functions in Matlab or manually. Also, it should be carefully noted here that the trajectory can be different types even if the initial and the final angles are known. The correct way to do it is to plan the path beforehand by intuition and select the knot points accordingly.

Equations of Spline functions –

Θ (t=0) -> C0 = 30 (for joint 1) || C0 = -110 (for joint 2)

d(Θ (t=0)) -> C1 = 0 .....(since velocity is zero at the start)

Θ (t=1) = C0 + C1 + C2 + C3 = 47.64 (joint1) and -122.8 (joint2)

d(Θ (t=1)) = C1 + 2*C2 + 3*C3 = 2 .....(assuming velocity is 2deg/sec)

Θ (t=2) = C0 + 2*C1 + 4*C2 + 8*C3 = 87.74 (joint1) and -122.8 (joint2)

d(Θ (t=2)) = C1 + 4*C2 + 12*C3 = 2.....(velocity is constant)

Θ (t=3) -> C0 + 3*C1 + 9*C2 + 27*C3 = 63.86 (for joint 1) and 117.8 (for joint 2)

d(Θ (t=3)) -> C1 + 6*C2 + 27*C3 = 2.....(velocity is constant)

Θ (t=4) -> C0 + 4*C1 + 16*C2 + 64*C3 = 180 (for joint 1) and 0 (for joint 2)

d(Θ (t=4)) -> C1 + 8*C2 + 48*C3 = 0.....(velocity is zero at the end)

Flowchart