MEAM620
Homework No. 6
Instructor: Savvas Loizou
Due: 11 April 2007

March 26, 2007

Navigation of Non-holonomic systems on star shaped worlds

1. Assume a world with 4 star shaped obstacles (max 3 ellipsoids). Construct a navigation function on this world. Create the Matlab functions *phis(x)* and *gradphis(x)* that returns the navigation function and its gradient at each point of workspace. Create a 3-D and/or a contour plot of the navigation function.

2. Consider the non-holonomic system:

$$\begin{bmatrix} \dot{x} \\ \dot{y} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} v\cos\theta \\ v\sin\theta \\ w \end{bmatrix}$$

   Construct a feedback linearization controller for this system assuming that $\|u\| \leq 1$ and $\|w\| \leq 1$. Propose a controller that will guarantee navigation for this system on the star shaped world of the previous exercise. Justify your selection and provide plots of the trajectories of your system as well as state vs time graphs.

3. Assume the non-holonomic unicycle defined in the previous exercise and the same star shaped world. Moreover assume that the goal q_d is not static but it is moving, i.e. $q_d = q_d(t)$ and $q_d(t)$ is known. Propose a tracking controller that will track q_d while avoiding collisions with obstacles. What classes of trajectories can be followed? (Remember the system has upper bounds on the achievable velocities). Justify your selections providing a Lyapunov stability analysis. Provide plots of system and target trajectories as well as tracking error vs time.