CISC 3415
HW Assignment – 2 (3pts) **Maryam Kurbanova**

Note, for all these questions, but especially for questions 2–4, it is important for you to explain how you got your answer, which will typically mean showing the math you needed to do to get the answer.

1. (**1pt**) You are the chief robot designer for U.S. Robots and Mechanical Men, Inc. You have to design robots that will operate in the following environments:

(a) A delivery robot that will carry supplies to different departments in a hospital.

-A wheeled robot with bumpers would be ideal. Hospital surfaces are smooth and flat so wheels are best since they don't take up much energy. The robot must have space in it to carry supplies. This robot's locomotion would be wheeled locomotion with differential drive or omni-wheels.

(b) A supply robot that will carry heavy loads across loose soil and sand.

-A robot with caterpillar tracks suits an environment that has soil and sand. Caterpillar wheels have more surface area than regular wheels so it would be able to go through rougher terrain like soil better. This robot's locomotion would be tracked so that it has better traction and would be able to free itself if stuck.

(c) A security robot that has to secure a wooded, hilly, area.

-The ideal robot for this environment would have legs in order to support itself through obstacles like hills and rocks. Even though legged robots take more energy it is better suited since wheeled robots would get stuck in an environment like this.

(d) A butler robot that will greet guests in a home and bring them drinks.

-A wheeled robot would suit this environment since homes normally have flat surfaces. It would also need sensors like a bumper in order to navigate through furniture. For each environment, write down the kind of locomotion that you think will work best for the robot and say why you think that this is the case.

2. (**1pt**) A Create robot has wheels with a 5 cm radius and which are 30 cm apart. The robot uses a differential drive. Compute the velocity of the robot, measured in terms of $\dot{x}R$, $\dot{y}R$, and $\dot{\theta}R$, when the robot's wheels are rotating as follows:

(a) Both wheels are rotating clockwise (when viewed from position A in Figure 1, shown below) at a speed of 1 radian per second.

- *$\dot{x}R$= 0.05m/s The radius of the wheel (0.05 m) multiplied by the angular velocity*,

$\dot{y}R$ =0 m/s (since both wheels are moving at the same speed there is no sideways movement), and

$\dot{\theta}R$= 0 rad/s (there is no center of rotation because the wheels are moving at the same speed, hence the angular velocity is 0).

(b) The right wheel is rotating clockwise (when viewed from position A in the figure) at a speed of 1 radian per second, and the left wheel is rotating in the opposite direction at a speed of 0.5 radians per second. Your answer should give $\dot{x}R$ and $\dot{y}R$ in meters per second, and $\dot{\theta}R$in radians per second.

- $\dot{x}$R= 0.0125 m/s

The robot's right wheel's velocity at the x direction is 0.05m x 1 rad/s = 0.05m/s and the robot's left wheel's velocity at the x direction is 0.05m x -0.5 rad/s = -0.025m/s. Finding the average would be (0.05-0.025)/2 =0.0125.

- $\dot{y}$R = 0.00625m/s

(VR-VL) x (r/2L). (0.05--0.025)= 0.075   0.075x 0.05m/0.06m=0.00625m/s

- $\dot{\theta}R$= 0.0125 rad/s

(VR-VL) x (r/L). (0.05--0.025)= 0.075   0.075x 0.05m/0.03m=0.0125rad/s

3. (**0.5pt**) Consider the Create robot, as described in the previous question. If both of its wheels are rotating clockwise (when viewed from position A in the Figure shown below) at a speed of 1 radian per second (as in part 2.a of the previous question), and *θI* is 35 degrees, what is the velocity of the robot in terms of $\dot{x}I$, $\dot{y}I$, and $\dot{\theta}I$?

-$\dot{x}I$= xR cos(θI)- yR sin(θI),   xR cos(0.6109)- 0x sin(0.6109) , 0.05m x cos(0.6109)=0.04095m/s

- $\dot{y}I$= xR sin(θI)- yR cos(θI), xR sin(0.6109)- 0xcos(0.6109), 0.05 x sin(0.6109)= 0.0287m/s

-$\dot{\theta}I$= 0 rad/s because the wheels are rotating at the same time with same speed.

4. (**0.5pt**) If the robot from the previous question starts at a location of *xI* = 2 and *yI* = 1 (both coordinates in meters), and drives for 10 seconds with both wheels rotating at 1 radian per second, what will its final location be?

In the figure below, subscript I represents the global reference frame (Inertial), and subscript R represents the local reference frame (Robot's).

x=0.04095 x 10 +2 =2.4095 m, y= 0.0287 x 10+1 =1.289 m   - final location:(2.41, 1.29)