Formulas

1 Orthogonal Rotation Matrix

$$R(\theta) = \begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \tag{1}$$

2 Forward Kinematics Model

$$\dot{\xi}_I = R(\theta)^{-1} \begin{bmatrix} \frac{r\dot{\phi}_1}{2} + \frac{r\dot{\phi}_2}{2} \\ 0 \\ \frac{r\dot{\phi}_1}{2l} + \frac{-r\dot{\phi}_2}{2l} \end{bmatrix} \tag{2}$$

CS 460/560: Kinematics Homework

Name: _____

1. (6 points) Assume the robot has a velocity of (6 cm/s, 4 cm/s, 12 rad/s) in the global reference frame and is positioned at P and $\theta = \frac{\pi}{2}$ with respect to the global reference frame. What is the velocity with respect to the robot's local reference frame?

2. (6 points) Assume the robot has a velocity of (6 cm/s, 2cm/s, 18 rad/s) in the local reference frame and is positioned at P and $\theta = \frac{3\pi}{2}$ with respect to the global reference frame. What is the velocity with respect to the robot's global reference frame?

3. (6 points) Assume the robot has a velocity of (1 cm/s, 3cm/s) in the local reference frame. What is the velocity with respect to the robot's global reference frame?

4. (6 points) A robot is positioned at a 90 degree angle ($\theta = \frac{\pi}{2}$) with respect to the global reference frame and has wheels with a radius of 6 cm. These wheels are 2 cm from the center of the chassis. The speed of wheel 1 is 8 rad/s and the speed of wheel 2 is 4 rad/s. What is the robot's velocity with respect to the global reference frame?