

ECE 417 --- ROBOTICS

Homework 4, Fall 2018

Write the solution for each of the following in terms of atan2 before giving your final answer (e.g., $\theta = \text{atan2}(a,b) = \dots$)

1. If $\sin \theta = -1/2$ and $\cos \theta = \sqrt{3} / 2$ what is θ ?
2. If $-\kappa \sin \theta = 3$ and $\kappa \cos \theta = 3 \sqrt{3}$ what is θ ?
3. If $\sin \phi \sin \theta = 0.2$ and $\sin \phi \cos \theta = -0.3$ and $\sin \phi > 0$ what is θ ? Repeat for $\sin \phi < 0$.
4. If $-\sin \phi \sin \theta = 0.2$ and $\sin \phi \cos \theta = 0.3$ and $\sin \phi > 0$ what is θ ? Repeat for $\sin \phi < 0$.
5. Using the System II matrix solve for $\phi + \psi$ in terms of the matrix elements r_{ij} if $\theta = 0$ degrees. Also solve for $\phi - \psi$ if $\theta = 180$ degrees.
6. Using the System I matrix (given below) solve for ϕ , θ , and ψ in terms of the matrix elements r_{ij} . Include solutions for the special cases for θ .

System I

$$\begin{bmatrix}
 \cos \phi \cos \psi - \sin \phi \cos \theta \sin \psi & -\cos \phi \sin \psi - \sin \phi \cos \theta \cos \psi & \sin \phi \sin \theta \\
 \sin \phi \cos \psi + \cos \phi \cos \theta \sin \psi & -\sin \phi \sin \psi + \cos \phi \cos \theta \cos \psi & -\cos \phi \sin \theta \\
 \sin \theta \sin \psi & \sin \theta \cos \psi & \cos \theta
 \end{bmatrix}$$