Congratulations! You passed!

TO PASS 75% or higher

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Module 3: Graded Quiz

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1. Which of these statements are true? Select any/all that apply: **1 / 1 point**

- [x] Every unit quaternion has an associated 3x3 rotation matrix.

Correct
Correct! Every quaternion corresponds to a 3x3 rotation matrix.

- [ ] Every 3x3 matrix represents a 3D rotation.
- [x] Every set of Euler angles corresponds to a unit quaternion.

Correct
Correct! Any set of Euler angles represents a rotation which can also be represented by a unit quaternion.

2. Which of these are valid rotation matrices? Select any/all that apply: **2 / 2 points**

$$\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix}$$

$C_4 = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \end{bmatrix}$

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \\ 0 & -\frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{bmatrix}$$

$C_2 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \\ 0 & -\frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{bmatrix}$

Correct

Correct! $C_2 C_2^T = \mathbf{I}$ holds and $\det C_2 = 1$.

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$C_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Correct

Correct! Since C_1 is an identity matrix, it is equivalent to performing "zero" rotation.

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \\ 0 & \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{bmatrix}$$

$$C_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \\ 0 & \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{bmatrix}$$

3. Localization can be performed on board a vehicle by integrating the rotational velocities and linear accelerations measured by an IMU. Assuming that the IMU measurement noise is drawn from a normal distribution, what will the pose estimation error look like? **1 / 1 point**

- (●) The vehicle pose estimation error will grow with time.
- ( ) The vehicle pose estimate error will remain within a bounded interval.
- ( ) The vehicle pose estimate error will decrease with time.

✓ **Correct**

Correct! Since we are integrating noisy measurements, the error will build up over time.

4. Each GPS satellite transmits a signal that encodes: **1 / 1 point**

- ( ) The receiver's position and time of signal transmission
- (●) The satellite's position and time of signal transmission.

✓ **Correct**

Correct! This information can be used to calculate the vehicle's position.

5. Which of these systems provides the most accurate positioning measurement? **1 / 1 point**

- (●) RTK GPS
- ( ) GPS
- ( ) DGPS

✓ **Correct**

Correct! RTK uses phase of the GPS carrier signal to provide centimetre-level accuracy.

6. What is the minimum number of GPS satellites required to estimate the 3D position of a vehicle through trilateration? **2 / 2 points**

4

✓ **Correct**

Correct! A minimum of four satellites is required to unambiguously calculate the vehicle's 3D position.