Congratulations! You passed!

Grade received 100% To pass 80% or higher

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1. Although we use six numbers to represent a screw $\mathcal{S} = (\mathcal{S}_\omega, \mathcal{S}_v)$, the space of all screws is only 5-dimensional. Why? 1 / 1 point

- ○ $\mathcal{S}_\omega$ must be unit length.
- ○ $\mathcal{S}_v$ must be unit length.
- ◉ Either $\mathcal{S}_\omega$ or $\mathcal{S}_v$ must be unit length.

Correct
If both the angular and linear components of the screw are nonzero, then the screw is defined so that $\|\mathcal{S}_\omega\| = 1$.

2. A transformation matrix T_{ab}, representing {b} relative to {a}, can be represented using the 6-vector exponential coordinates $\mathcal{S}\theta$, where $\mathcal{S}$ is a screw axis (represented in {a} coordinates) and θ is the distance followed along the screw axis that displaces {a} to {b}. Which of the following is correct? Select all that apply. 1 / 1 point

- ☐ $T_{ab} = e^{\mathcal{S}\theta}$
- ☑ $T_{ab} = e^{[\mathcal{S}]\theta}$

Correct
θ is just a scalar, so $[\mathcal{S}]\theta = [\mathcal{S}\theta]$.

- ☑ $T_{ab} = e^{[\mathcal{S}\theta]}$

Correct
θ is just a scalar, so $[\mathcal{S}]\theta = [\mathcal{S}\theta]$.

- ☐ $T_{ab} = e^{\mathcal{S}[\theta]}$

3. The matrix representation of the exponential coordinates $\mathcal{S}\theta \in \mathbb{R}^6$ is $[\mathcal{S}\theta]$. What space does $[\mathcal{S}\theta]$ belong to? 1 / 1 point

- ○ $SO(3)$
- ○ $so(3)$
- ○ $SE(3)$
- ◉ $se(3)$

Correct
This is the space of matrix representations of twists (and exponential coordinates).

4. $T_{ab'} = T_{ab}e^{[\mathcal{S}\theta]}$ is a representation of the new frame {b'} (relative to {a}) achieved after {b} has followed 1 / 1 point

- ◉ the screw axis $\mathcal{S}$, expressed in {b} coordinates, a distance θ.
- ○ the screw axis $\mathcal{S}$, expressed in {a} coordinates, a distance θ.

Correct
Multiplying the matrix exponential on the right means that $\mathcal{S}$ is interpreted as being represented in the frame {b} (the second subscript of T_{ab}).

5. $T_{ab'} = e^{[\mathcal{S}\theta]}T_{ab}$ is a representation of the new frame {b'} (relative to {a}) achieved after {b} has followed 1 / 1 point

- ○ the screw axis $\mathcal{S}$, expressed in {b} coordinates, a distance θ.
- ◉ the screw axis $\mathcal{S}$, expressed in {a} coordinates, a distance θ.

Correct
Multiplying the matrix exponential on the left means that $\mathcal{S}$ is interpreted as being represented in the frame {a} (the first subscript of T_{ab}).

6. Which of the following statements is true? Select all that apply. 1 / 1 point

- [x] The matrix exponential maps $[\mathcal{S}\theta] \in se(3)$ to a transformation matrix $T \in SE(3)$, where T is the representation of the frame (relative to {s}) that is achieved by following the screw $\mathcal{S}$ (expressed in {s}) a distance θ from the identity configuration (i.e., a frame initially coincident with {s}).

  Correct

- [x] The matrix exponential maps $[\mathcal{V}] \in se(3)$ to a transformation matrix $T \in SE(3)$, where T is the representation of the frame (relative to {s}) that is achieved by following the twist $\mathcal{V}$ (expressed in {s}) for unit time from the identity configuration (i.e., a frame initially coincident with {s}).

  Correct
  If we choose $\mathcal{V} = \mathcal{S}\theta$, then following the twist $\mathcal{V}$ for unit time is equivalent to following the screw axis $\mathcal{S}$ a distance θ.

- [ ] The matrix log maps an element of $se(3)$ to an element of $SE(3)$.
- [x] The matrix log maps an element of $SE(3)$ to an element of $se(3)$.

  Correct

- [x] There is a one-to-one mapping between twists and elements of $se(3)$.

  Correct