Congratulations! You passed!

Grade received 100% To pass 80% or higher

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1. The solution to the differential equation $\dot{p}(t) = \hat{\omega} \times p(t) = [\hat{\omega}]p(t)$ is $p(t) = e^{[\hat{\omega}]\theta}p(0)$, where $p(0)$ is the initial vector and $p(t)$ is the vector after it has been rotated at the angular velocity $\hat{\omega}$ for time $t = \theta$ (where $\hat{\omega}\theta$ are the exponential coordinates). You can think of $R = e^{[\hat{\omega}]\theta}$ as the rotation operation that moves $p(0)$ to $p(\theta) = p(\theta)$.

1 / 1 point

Which of the following statements is correct? Select all that apply.

- [x] $R_{ab} = R_{ab}e^{[\hat{w}]\theta}$ represents the orientation of a new frame [b'] relative to [a] after the frame [b] has been rotated by θ about an axis w represented in the [b] frame as $\hat{\omega}$.

  Correct
  Multiplication of the rotation operation on the right corresponds to ω being interpreted in the frame of the second subscript, [b].

- [ ] $R_{ab} = R_{ab}e^{[\hat{w}]\theta}$ represents the orientation of a new frame [b'] relative to [a] after the frame [b] has been rotated by θ about an axis w represented in the [a] frame as $\hat{\omega}$.
- [ ] $R_{ab} = e^{[\hat{\omega}]\theta}R_{ab}$ represents the orientation of a new frame [b'] relative to [a] after the frame [b] has been rotated by θ about an axis w represented in the [b] frame as $\hat{\omega}$.
- [x] $R_{ab} = e^{[\hat{\omega}]\theta}R_{ab}$ represents the orientation of a new frame [b'] relative to [a] after the frame [b] has been rotated by θ about an axis w represented in the [a] frame as $\hat{\omega}$.

  Correct
  Multiplication of the rotation operation on the left corresponds to ω being interpreted in the frame of the first subscript, [a].

2. The simple closed-form solution to the infinite series for the matrix exponential when the matrix is an element of $so(3)$ (a skew-symmetric 3x3 matrix) is called what?

1 / 1 point

- ○ Remired's formula.
- ◉ Rodrigues' formula.
- ○ Robertson's formula.

Correct

3. The matrix exponential and the matrix log relate a rotation matrix (an element of $SO(3)$) and the skew-symmetric representation of the exponential coordinates (elements of $so(3)$), which can also be thought of as the $so(3)$ representation of the angular velocity followed for unit time. Which of the following statements is correct? Select all that apply.

1 / 1 point

- [x] exp: $so(3) \to SO(3)$

  Correct
  The matrix exponential "integrates" the skew-symmetric $so(3)$ representation of an angular velocity for unit time to yield the rotation matrix describing the orientation achieved after rotating from an initial orientation described by the identity matrix.

- [ ] exp: $SO(3) \to so(3)$
- [ ] log: $so(3) \to SO(3)$
- [x] log: $SO(3) \to so(3)$

  Correct
  The matrix logarithm of a rotation matrix R gives the angular velocity that must be followed for unit time, starting from a frame represented as the identity matrix, to rotate to R. It "differentiates" the net rotational displacement to find the angular velocity that must be followed for unit time.