Lecture Comprehension, Angular Velocities (Chapter 3.2.2)

TOTAL POINTS 6

1. Our representation of the three-dimensional orientation uses an implicit representation (a 3x3 SO(3) matrix with 9 numbers), but our usual representation of the angular velocity uses only three numbers, i.e., an explicit parametrization of the three-dimensional velocity space. Why do we use an implicit representation of the orientation but an explicit parametrization of the angular velocity?

1 / 1 point

- [ ] There is no natural implicit representation of an angular velocity.
- [x] The space of angular velocities can be equated to a "flat" 3d space (a linear vector space) tangent to the curved 3d surface of orientations at any given time, so it can be globally represented by 3 numbers without singularities. The space of orientations, on the other hand, is not flat, and cannot be globally represented by 3 numbers without a singularity.

✓ **Correct**

2. A rotation matrix is an element of which space?

1 / 1 point

- [ ] $\mathbb{R}^3$
- [x] $SO(3)$
- [ ] $so(3)$

✓ **Correct**

3. An angular velocity is an element of which space?

1 / 1 point

- [x] $\mathbb{R}^3$
- [ ] $SO(3)$
- [ ] $so(3)$

✓ **Correct**

4. The 3x3 skew-symmetric matrix representation of an angular velocity is an element of which space?

1 / 1 point

- ○ $\mathbb{R}^3$
- ○ $SO(3)$
- ◉ $so(3)$

✓ **Correct**

5. If an angular velocity is represented as ω_b in the body frame {b}, what is the representation of the same angular velocity in the space frame {s}?

1 / 1 point

- ◉ $R_{sb}\omega_b$
- ○ $R_{bs}\omega_b$
- ○ $\omega_b R_{sb}$
- ○ $\omega_b R_{bs}$

✓ **Correct**

This is correct by the subscript cancellation rule.

6. The cross-product $\omega \times p$ can be written $[\omega]p$, where $[\omega]$ is

1 / 1 point

- ○ the $SO(3)$ representation of ω.
- ◉ the skew-symmetric $so(3)$ representation of ω.

✓ **Correct**

The 3x3 skew-symmetric matrix representation of a 3-vector allows calculating a cross product using matrix multiplication.