Lecture Comprehension, Homogeneous Transformation Matrices (Chapter 3 through 3.3.1)

TOTAL POINTS 4

1. A 4x4 transformation matrix (element of $SE(3)$) consists of a rotation matrix, a 3-vector, and a row consisting of three zeros and a one. What is the purpose of the row of 4 constants?

   1 / 1 point

   - ○ This row is a historical artifact.
   - ◉ This row allows simple matrix operations for useful calculations.

   ✓ **Correct**

2. Which of the following are possible uses of a transformation matrix? Select all that apply.

   1 / 1 point

   - [x] Displace (rotate and translate) a frame.

     ✓ **Correct**

   - [x] Displace a vector.

     ✓ **Correct**

   - [x] Change the frame of reference of a vector.

     ✓ **Correct**

   - [x] Represent the position and orientation of one frame relative to another.

     ✓ **Correct**

3. The representation of a point p in the {b} frame is $p_b \in \mathbb{R}^3$. To find the representation of this point in the {a} frame, we could write $T_{ab}p_b$, but there is a dimension mismatch; p_b has only 3 components, but T_{ab} is 4x4. How do we alter p_b to allow this matrix operation?

1 / 1 point

- (x) Put a 1 in the last row of p_b, making it a 4-element column vector, and otherwise ignore the last row in your interpretation of the 4-vector.
- ( ) Put a 0 in the last row of p_b, making it a 4-element column vector, and otherwise ignore the last row in your interpretation of the 4-vector.

✓ Correct

4. Which of these is a valid calculation of T_{ab}, the configuration of the frame {b} relative to {a}? Select all that apply.

1 / 1 point

- [x] $T_{ac}T_{cb}$

✓ Correct
Correct by subscript cancellation rule.

- [ ] $T_{cb}T_{ac}$
- [x] $T_{ac}T_{dc}^{-1}T_{db}$

✓ Correct
T_{dc}^{-1} is equivalent to T_{cd}, so this is correct by the subscript cancellation rule.

- [x] $(T_{bc}T_{ca})^{-1}$

✓ Correct
Assuming the matrices A and B are invertible, then the following identity holds: $(AB)^{-1} = B^{-1}A^{-1}$. Then the expression is correct from our subscript cancellation rule.