Lecture Comprehension, Degrees of Freedom of a Robot (Chapter 2.2)

TOTAL POINTS 3

1. Consider a joint between two rigid bodies. Each rigid body has m degrees of freedom ($m = 3$ for a planar rigid body and $m = 6$ for a spatial rigid body) in the absence of any constraints. The joint has f degrees of freedom (e.g., $f = 1$ for a revolute joint or $f = 3$ for a spherical joint). How many constraints does the joint place on the motion of one rigid body relative to the other? Write your answer as a mathematical expression in terms of m and f.

1 / 1 point

Preview
$-f + m$

m-f

Correct
Since the second body only has f freedoms relative to the first body, the joint must place $m - f$ constraints on the m motion freedoms of the second body.

2. Consider a mechanism consisting of three spatial rigid bodies (including ground, $N = 4$) and four joints: one revolute, one prismatic, one universal, and one spherical. According to Grubler's formula, how many degrees of freedom does the mechanism have?

1 / 1 point

Preview
1

1

Correct
In Grubler's formula, $N = 4, m = 6, J = 4$, and the sum of joint freedoms is $1 + 1 + 2 + 3 = 7$, giving $6(4 - 4 - 1) + 7 = 1$ dof.

3. A mechanism that is incapable of motion has zero degrees of freedom. In some circumstances, Grubler's formula indicates that the number of degrees of freedom of a mechanism is negative. How should that result be interpreted?

1 / 1 point

- (•) The constraints implied by the joints must not be independent.
- ( ) The number of joints, the degrees of freedom of those joints, or the number of rigid bodies must have been counted incorrectly.