Congratulations! You passed!

Grade received 100% To pass 80% or higher

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1. True or false? A nonholonomic constraint implies a configuration constraint. 1 / 1 point

- ○ True.
- ◉ False.

Correct
A nonholonomic constraint is a velocity constraint that cannot be integrated to a configuration constraint.

2. True or false? A Pfaffian velocity constraint is necessarily nonholonomic. 1 / 1 point

- ○ True.
- ◉ False.

Correct
A Pfaffian velocity constraint can be nonholonomic (nonintegrable), or it can be the derivative of a holonomic configuration constraint.

3. A wheel moving in free space has the six degrees of freedom of a rigid body. If we constrain it to be upright on a plane (no "leaning") and to roll without slipping, how many holonomic and nonholonomic constraints is the wheel subject to? 1 / 1 point

- ◉ Two holonomic constraints and two nonholonomic constraints.
- ○ Three holonomic constraints and zero nonholonomic constraints.
- ○ Zero holonomic constraints and three nonholonomic constraints.
- ○ One holonomic constraint and two nonholonomic constraints.

Correct
Two holonomic constraints (1) make the wheel upright and (2) put it in contact with the plane. This means that the C-space has 4 degrees of freedom (6 dof of a rigid body minus 2 constraints equals 4 dof), which could be described by 2 variables describing the contact point on the plane ($\mathbb{R}^2$), 1 variable describing the heading direction (S^1), and 1 variable describing which point on the boundary of the wheel is in contact with the ground (S^1), for a C-space of $\mathbb{R}^2 \times T^2$. The two nonholonomic constraints relate the x and y linear velocities to the rolling speed and heading direction. There are two controlled input velocities, the rolling speed and the turning speed, which makes sense, since we have 4 dof minus 2 nonholonomic velocity constraints equals 2 velocities we can control.

4. How many degrees of freedom does the upright wheel on the plane have? (What is the minimum number of coordinates needed to describe its configuration?) 1 / 1 point

4

4

Correct
Two variables specify the contact point on the plane, a third specifies the point on the wheel in contact with the ground, and a fourth specifies the heading direction of the wheel.