NOTA:
Isto são apenas propostas de resoluções, feitas a partir dos slides da disciplina e outras fontes 😈.
Podem haver cenas mal. Por favor, não tomem estas respostas como único material de estudo se pretendem obter uma nota minimamente aceitável.
Boa sorte amén CT 👼🏽👼🏽
Props Professor Corujo pelos slides.

Group I

1. **The use of hydraulic actuators in mobile robotics is appropriate if:**
    a. We want an actuator capable of developing high forces, with a high degree of position
    b. We want a simple method of control, preferably for linear motion, but the required force is not a critical element**.**
    c. we want a linear actuator, with high positioning precision, easy to integrate in s.. mobile robots
    d. we want a simple control method, preferably for rotary movements, where the required force is a critical element.

3. Hydraulic. They use the flow and pressure of a fluid to convert the primary energy into linear and/or rotational motion or torque.

Such actuators are used only in **situations where the force required is extremely high**. They also require **heavy and bulky mechanical structures**.

Typically found in large machines such as autonomous mobile robots working in mines. In the field of robots covered by this course this is not a relevant type of actuator.

2. **When we refer to an actuator as being compliant, we are talking about actuators:**
    a. which include force sensors for the purpose of recording the actuation process and subsequent analysis of the results.
    b. which include passive elements that absorb part of the impact energy and transform … another form of dissipated energy.
    c. that ensure a result in terms of rotational speed, position or exerted force within limits of certainty in relation to the intended objectives.

d. where part of the primary energy is stored in passive energy storage elements, wh… be influenced by forces outside the system.

NOTES:

1. When the objective is the direct application of a force, it is common to find solutions where the primary power applied to the actuator is partially stored in a mechanical device (e.g. a spring) so that the original configuration can be restored when the primary energy source is removed. Passive energy storage elements can also adjust target positions based on external forces (**compliant actuators as opposed to stiff**).

3. **Electric motors in which the rotor consists of a permanent magnet and the stator, is commonly called:**
   a. stepper motors.
   b. BLDC motors.
   c. DC motors
   d. AC motors.

Brushed DC motors

In the version shown in the image, there are two poles (**permanent magnets**) which constitute the **stator**.

The **rotor** includes two coils wounded around ferromagnetic armatures that, when traversed by current, generate a magnetic field that, in conjunction with the field of the permanent magnets, generates a **rotational force**.

4. **The main elements that can make up a servo motor are:**
   a. a stepper motor, a position measurement element and an open loop controller.
   b. a DC motor, a gearbox, a position measurement element and a closed loop controller.
   c. a DC motor, a gearbox, a speed measuring element and an open loop controller.
   d. a BLDC motor, a gearbox, a position measurement element and an open loop.

Servo Motors

Servo (or **servo motor**) is the name given to a combination of a **DC (or BLDC) motor**, a **reduction gear box** and an **electronic control loop**.

Servos are intended, usually, for applications of **angular positioning** which require **good accuracy** (which can also be transformed into linear movement)

In the simplest servos, the control is carried out by applying a PWM signal to the servo. The feedback loop includes a potentiometer which indicates the angular position of the output shaft.

5. **If you wanted to choose an electric motor for an application where the main requisite … to control and with a wide range of power, you would choose:**
    a. DC motors.
    b. Servo motors.
    c. BLDC motors.
    d. stenner motors

Brushed DC	Brushless DC	Stepper Motors
+ cheap	+ efficiency	+ very precise (can be used in open loop)
+ simple to control	+ large range of rotational speeds	+ good for planar topologies
+ large power range	+ maintenance	+ useful in positioning applications
+ very simple startup	+ power vs. volume	+ maintenance
-	+ good for planar topologies - price	+- reasonable compromise between complexity and control
- mechanical wear-out	- complex control	-- price
- efficiency	- complex startup and/or need for acurate position sensors	-- efficiency
- power vs. volume		- mechanical vibration

6. **To detect if a robot has fallen of flipped over(it is not in the upright position), you would use:**
    a. an encoder.
    b. a potentiometer.
    c. an accelerometer.
    d. a Laser Range Finder

Um accelerometro é um sensor que mede a aceleração linear do robô em diferentes direções. Ao monitorizar as mudanças na aceleração, o acelerómetro pode determinar se o robô caiu ou virou, pois esses eventos causam mudanças muito bruscas e repentinas na aceleração registrada.

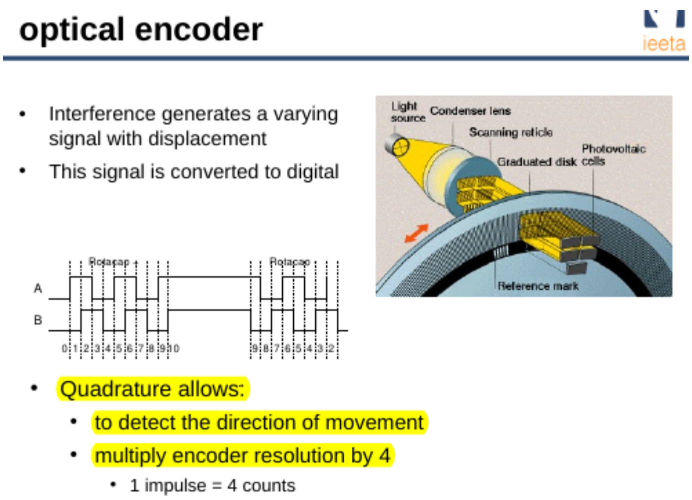
7. **A gyroscope is a sensor used:**
    a. to measure how fast a device rotates.
    b. to measure linear acceleration.
    c. to detect impact
    d. to measure changes in orientation of a device

Gyroscopes

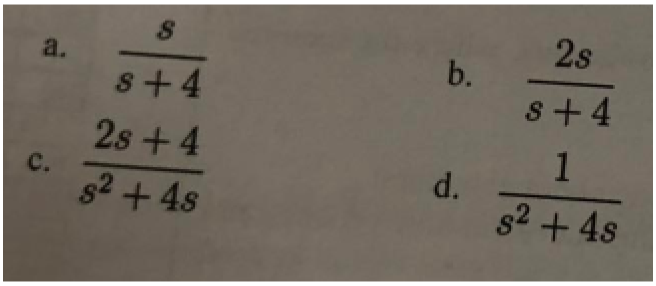
- Based on inertia principle
    - rotating disk
- Electronic devices based on mechanical oscillation
    - Foucault pendulum

Um gyroscope é um sensor que deteta rotações e movimentos angulares, permitindo medir com precisão as mudanças na orientação de um dispositivo.

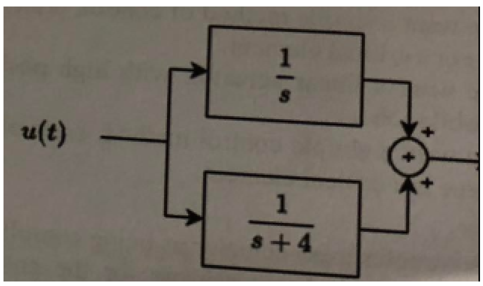
8. **Phase quadrature signals is a method used in optical encoders that allows:**
    a. to detect the sense of rotation (clockwise/anticlockwise).
    b. to increase the encoder resolution.
    c. to detect the sense of rotation and increase the encoder resolution.
    d. to make the encoder more robust regarding noise.



9. **Consider the block diagram on the right, displaying a system with two blocks. The transfer function corresponding to the aggregate of these two blocks is**

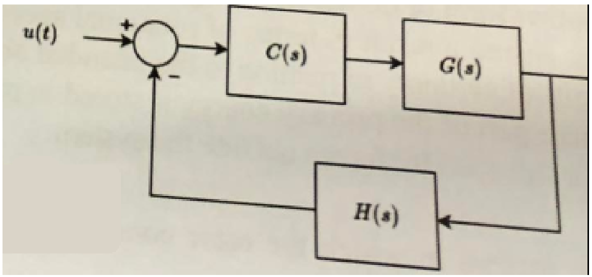


a. $\frac{s}{s+4}$
b. $\frac{2s}{s+4}$
c. $\frac{2s+4}{s^2+4s}$
d. $\frac{1}{s^2+4s}$



$$\frac{1}{s+4} + \frac{1}{s} = \frac{2s+4}{s^2+4s}$$

10. The transfer function of the system presented in the figure is:



a. $C(s) \cdot G(S) \cdot H(s)$

b. $\dfrac{C(s) \cdot G(s)}{1 + C(s) \cdot G(s) \cdot H(s)}$

c. $\dfrac{C(s)}{1 + C(s) \cdot G(s) \cdot H(s)}$

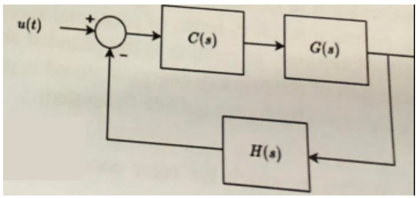
d. $\dfrac{1}{1 + C(s) \cdot G(s) \cdot H(s)}$

R: Como é retroalimentação negativa é a opção B

VER AS FORMULAS PARA RETROALIMENTAÇÃO POSITIVA !!!

11. **In the figure of the previous question, G(s) is the system to be control…**

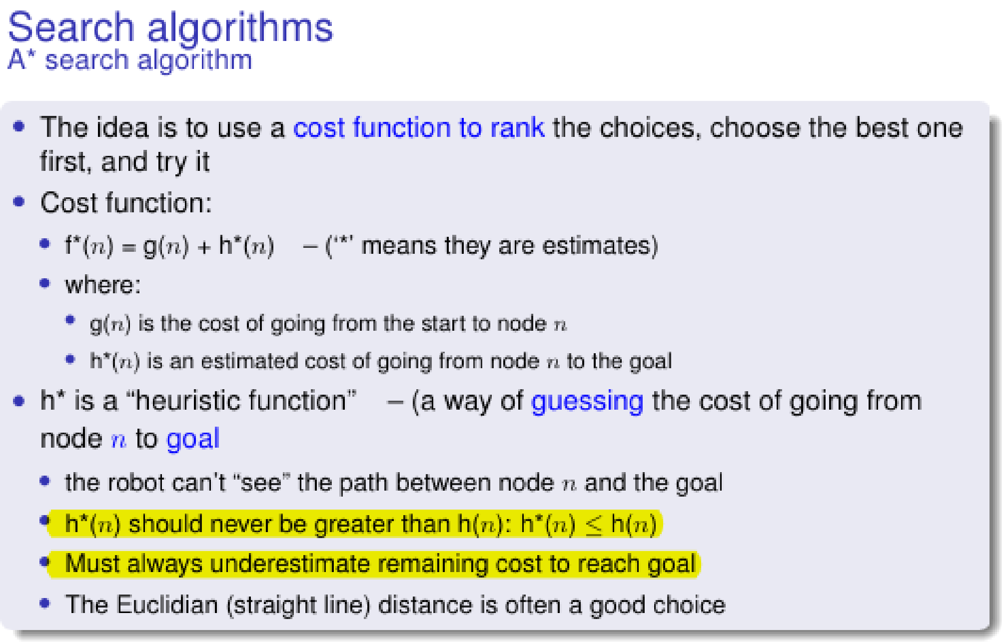
a. a sensor.
b. the feedback element.
c. the controller.
d. the optimizer.



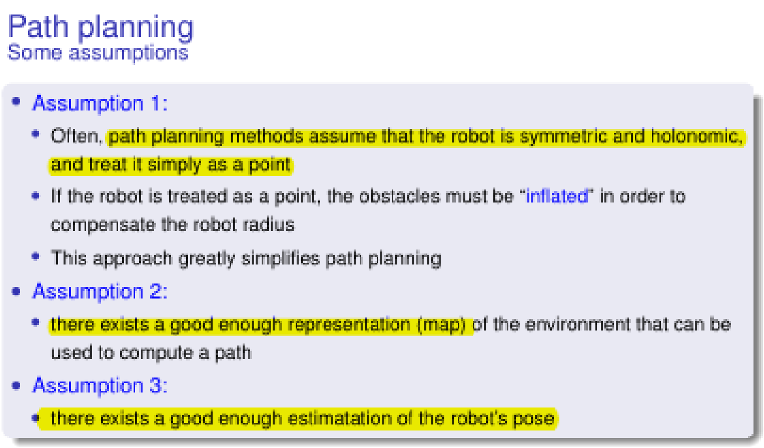
C(s) é o controller
H(s) é o feedback

12. **In the A* search algorithm, the cost function is the sum of two terms, the order to find an optimal path, the heuristic:**
   a. must be the Euclidian distance from the current node to the goal.
   b. must not overestimate the remaining cost to reach the goal.
   c. can not be zero.
   d. must always overestimate the remaining cost to reach the goal

15. **In**



mobile robotics, path planning algorithms usually consider some assumptions? → assumo que a pergunta seja para escolher a opção falsa porque b,c,d estão corretas
   a. the environment must be represented by a cell grid, where the cell's size is … robot's diameter.
   b. the robot is symmetric, holonomic and is treated as a point.
   c. the exists a good enough representation of the environment
   d. there exists a good enough estimation of the robot's pose.



16. **Consider the following definition of a certain image parameter: it represents the luminous intensity, per unit area, of light traveling in a given direction. We are talking about:**
    a. Saturation
    b. Luminance
    c. Brightness
    d. Contrast

Luminance

Luminance is normally defined as a measurement of the photometric luminous intensity per unit area of light travelling in a given direction.

17. **Consider the following definition of a certain image parameter: it is determined… that is acquired by a pixel and how much this light is distributed across the spectrum. We are talking about:**
    a. Sharpness of the image.
    b. White balance.
    c. Chrominance.
    d. Saturation of a color.

Saturation (as an intrinsic image characteristic)

The saturation of a color is determined by a combination of light intensity that is acquired by a pixel and how much this light it is distributed across the spectrum different wavelengths. The most purest (most saturated) color is obtained when using a single wavelength at a high intensity (laser light is a good example).

If the light intensity declines, then, as a result, the saturation also decline.

18. **Consider the following definition of a certain image parameter: it is the global a… colors (typically red, green, and blue primary colors) necessary to render specific… –correctly. We are talking about:**
    a. White balance.
    b. Gamma.
    c. Saturation.
    d. Sharpness.

White Balance (as controllable parameters)

White balance is the global adjustment of the intensities of the colors (typically red, green, and blue primary colors).

An important goal of this adjustment is to render specific colors – particularly neutral colors – correctly; hence, the general method is sometimes called gray balance, neutral balance, or white balance.

This balance is required because of different color spectrum energy distribution depending on the illumination source.

19. The image on the right represents one of the characteristics of a pixel. In this o looking at the following color space:

a. CYM(K) space.
b. Chromaticity Diagram.
c. U-V plane.
d. HCL space.

No image :(

20. A wheeled robot based on a three-wheel configuration:

a. requires a suspension system to be stable and to compensate for irregularities in the environment.
b. is statically stable if the center of mass is inside the triangle formed by the contact points of the wheels to the ground.
c. must be powered with a single motor.
d. is always stable.

Three wheels

- Stable configuration
- **Center of mass must be inside the triangle formed by the ground contact points of the wheels**

21. A wheeled robot based on a four-wheel configuration:

a. must use Ackerman steering drive.
b. can be powered by 4 independent motors and four differential gears.
c. requires a suspension system to compensate for irregularities in the environment where the robot has to move.
d. can be implemented with one active drive wheel and 3 passive castor wheels.

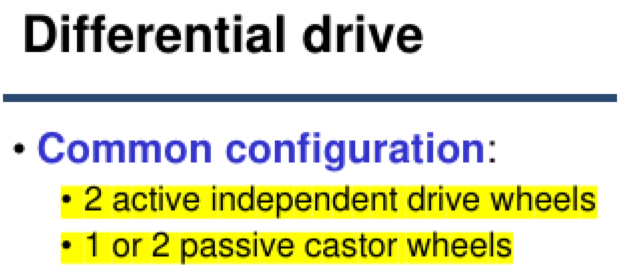
Four wheels

- Stable configuration
- **Requires a suspension system** to compensate for irregularities in the environment where the robot has to move

22. The differential drive is typically implemented with:

a. two active independent drive wheels and one or two passive castor wheels.

b. one active drive wheel and two passive steering wheels.
c. one active drive wheel and two or more passive castor wheels.
d. two passive normal wheels and one or two active castor wheels.

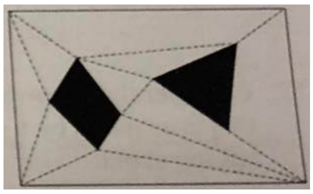


23. The Ackerman steering configuration can be implemented with:

a. two rear drive wheels and one front steering wheel.
b. two front drive and steering wheels and two rear castor wheels.
c. two rear drive wheels and one front steering castor wheel.
d. two front steering wheels and two rear drive wheels.

24. The aside figure represents a cell decomposition of an environment, where the black boxes are obstacles. In which one of the following cell decomposition approaches does it fit?

a. approximate cell decomposition.
b. exact cell decomposition.

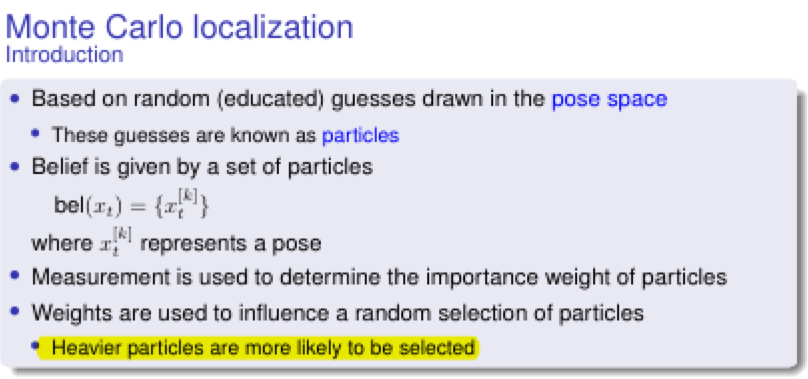


c. fixed-size cell decomposition.
d. triangular cell decomposition.

25. In the resampling phase of the Monte Carlo localization algorithm:

a. few of the lightest particles are kept to tackle with the kidnapping problem.
b. lighter particles are discarded.
c. heavier particles are more likely to be selected.
d. the heaviest particles are kept as they best represent the pose.

Grupo II



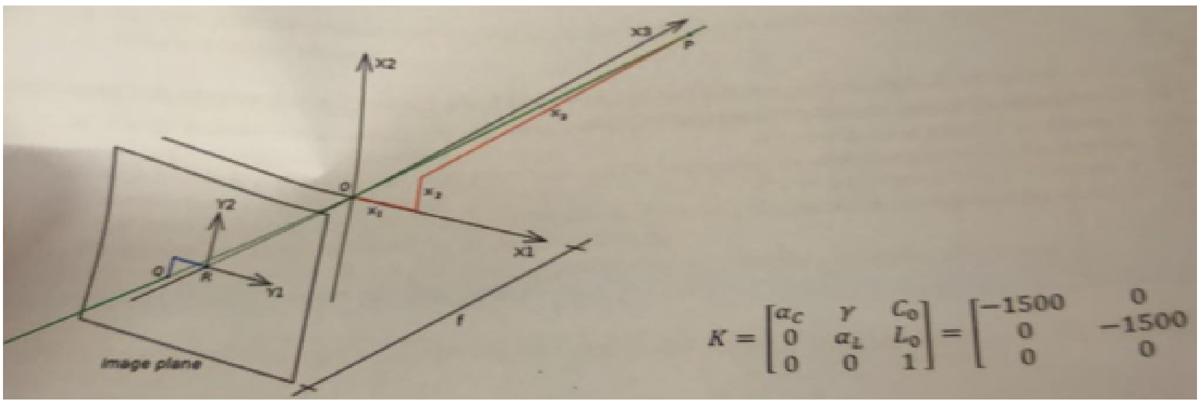
26. Consider a robot with tricycle drive with the following characteristics: distance between the rear wheels, 50cm; distance between the rear wheels and the front wheel, 75cm; wheels diameter, 10cm front wheel drive. The robot is turned on moving forward with a steering angle of 0º and, after a given period of time, the front wheel rotated 3.2 laps. Supposing that the initial pose of the robot was(x, y, θ)=(2.3cm, 4.6cm, π/6), at that time instant the new pose of the robot is, approximately:

a. p=(1.8, 3.7, π/6).
b. p=(4.0, 6.5, π/6).
c. p=(2.8, 5.5, π/6).
d. p=(3.2, 5.1, π/6).

Consider that:
cos(π/6)≈ 0.9, cos(π/4)≈0.7, cos(π/3)≈0.5

27. Consider an artificial vision system compromising a lens and a CMOS Sensor represented by the simplified pin… model shown above where the(X1,X2) plane represents the lens, the (Y1,Y2) plane represents the Image plane "R" represents the Principal Point of the system. The CMOS sensor has 1920x1080 square pixels with a side of 4μm each. Assume that the intrinsic parameter matrix of this system, K (units in pixels) is the one defined … right side of the picture below.

28.

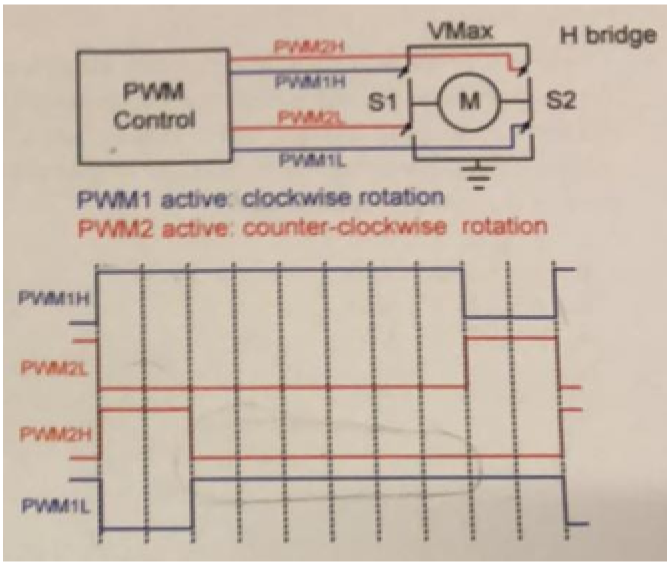


If point("P") lies at coordinates P=[x1,x2,x3]=[1,0.8,20] m in the (X1,X2,X3) coordinate system, and… point in the image plane has coordinates (Y1,Y2)=(780,470) the coordinates, expressed in pixels, of the… point "R" are:

a. [950, 550].
b. [920, 520].
c. [930, 530].
d. [960, 540].

28. A DC motor, attached to the wheel of a robot, has its rotation speed controlled by a PWM controller (picture on the right). This configuration allows the motor (and hence the wheel to rotate in both directions). Considering that, at a certain instant, the 4 outputs of the PWM controller have the time diagram shown in the same picture, we can say that the percentage of the maximum energy applied to the motor and its rotation direction is the following:

a. 60%, counter-clockwise rotation.
b. 60%, clockwise rotation.
c. 20% , clockwise rotation.
d. 20%, counter-clockwise rotation.



29. If you join, using the Kalman Filter, a belief that has a mean of 0 and variance 2 and a measure that has ... of 3 and variance of 4, you should get a new belief with:

a. a mean of 1.5 and a variance of 6.

b. a mean of 1.5 and a variance of 4/3.
c. a mean of 2 and a variance of 2/3.
d. a mean of 1 and a variance of 4/3.

$k = \frac{P_0}{P_0 + R}$ • $\hat{x}_0 = 0$ • $z = 3$
• $P_0 = 2$ • $R = 4$

$\hat{x}_1 = \hat{x}_0 + k \cdot (z - \hat{x}_0)$

$P_1 = (1 - k) \cdot P_0$

• $k = \frac{2}{2+4} = \frac{1}{3}$

• $\hat{x}_1 = 0 + \frac{1}{3} \cdot (3 - 0 = 1$

• $P_1 = (1 - \frac{1}{3}) \cdot 2 \approx \frac{4}{3}$

30. Suppose that the calculation of a rotation movement in an agent for a differential-drive robot results in a difference of (new_angle - previous_angle)=600°. In this case, in order to minimize the movement performed, the robot should rotate:

a. 120° clockwise.
b. 60° clock wise.
c. 60° counter-clockwise.
d. d. 240º counter-clockwise.

31. Havia uma pergunta que era defenição de chrominance