

## UNIT B Lab, part 1 : Robot Gears and Program Control

## vocabulary

- gear ratio
- rotational speed
- revolutions per minute (rpm)
- angular velocity
- torque
- idler gear
- robot control

## gears

In our previous lab sessions, we have used gears for reversing the direction and changing the speed of rotation of the wheel. Consider the gear configuration below:



In the image above, there are 2 gears: 10-tooth and 20-tooth. Gear 1 is connected to a motor, and Gear 2 is connected to a wheel. The gear connected to the motor is called the *drive* gear. Assume the motor is spinning clockwise at 100 rpm (revolutions per minute). How many times does the wheel rotate in a minute and in which direction (clockwise or counterclockwise)?

Answer:

- i. For each revolution of the motor, the drive gear (Gear 1, 10-tooth) will rotate once in the same direction as the motor (i.e., clockwise in this case).
- ii. In each revolution, Gear 1 will touch 10 of the teeth in Gear 2 (each tooth in Gear 1 will interlock with a tooth in Gear 2 and force Gear 2 to turn). Thus, Gear 2 will turn half a rotation in the opposite direction (i.e., counterclockwise in this case). The *gear ratio* is defined as the ratio of the gear being driven (in this case, Gear 2) to the gear doing the driving (in this case, Gear 1). In our example, this ratio is "Gear 2" to "Gear 1", or 2 : 1 (read "two to one"), meaning that for every two revolutions of the drive gear (Gear 1), the interlocking gear (Gear 2) will turn one revolution. This can also be stated as saying that for one rotation of Gear 1, Gear 2 will complete 1/2 a rotation.
- iii. Since Gear 2 is attached to the wheel, the wheel will also turn 1/2 a rotation for each rotation of the motor, counterclockwise in this case.
- iv. The motor spins 100 revolutions per minute. How many revolutions does the wheel rotate in a minute? We can find the answer by multiplying the number of revolutions the motor completes in a minute by the wheel revolution rate that we found above (i.e., 1/2). Therefore the answer is : 1/2 \* 100 = 50 revolutions, counterclockwise.

For each configurations below, determine how many times each gear rotates in a minute and in which direction (clockwise or counterclockwise). Assume that the motor is spinning clockwise at 200 rpm.



Answer:



Answer:



Answer:

## program control



1. The programs shown above are similar in functionality. Explain briefly how each program runs and explain the differences between them.

2. Work with your group member(s) to implement each program.