

# Navigation - Timing Verses Back EMF

**Objective:** Students will understand the advantages/disadvantages of using timing or BEMF for navigation.

**Procedure:** Students work in groups to build a simple robot that can be programmed to go forwards. The robot doesn't need to be able to turn. Demobot could be used, or the students could design a simple one or two motor robot. The robot should be able to travel in a straight line for about 3 feet. If the two motor robot won't travel in a straight line, try adjusting the speed of the motor on the side it is leaning towards or build a device to make the robot follow a yard/meter stick. Tape the meter stick to the table. See Sample Robot Pictures. For information on Back EMF see the Botball Workshop Guide 2005, pp. 114-115.

## Student Activity:

Write two programs that make the robot go forward approximately three feet and then stop at a target position. One program uses timing and the other uses the BEMF. Estimate and use trial and error to get the number of seconds and the ticks. It takes approximately 1100 ticks to turn the black gear motors one full rotation.

Run each program, record the position of the robot and compare how close the robot came to the target position. Mark a starting position for the robot. Each group should run the BEMF program 5 times in a row, recording on the worksheet how close the robot comes to the target position each time. (Return the robot to the starting position after each run.)

Then the group should repeat the process using the timing program. Have each group keep track of the time of day they started and ended. Do not turn off the robot until all groups have run both program loops. Start with a fully charged robot but do not charge during the exercise. After running both programs, answer the questions at the bottom of the BEMF Worksheet.

**Timing Example** for robot with two motors: The robot moves forward for 10 seconds and then stops.

```
void main()
{
  motor(1,50); //turns on motor 1 at half speed
  motor(2,50); //turns on motor 2 at half speed
  sleep(10.0); //waits for 10 seconds
              //remember you can use fractions of seconds (10.75) to be more precise
  ao(); //turns all motors off
}
```

**BEMF Example** for robot with two motors: The robot moves forward 5000 ticks and then stops.

```
void main()
{
  move_relative_position(1,500,5000L); //moves motor 1 5000 ticks at half speed
  move_relative_position(2,500,5000L); //moves motor 2 5000 ticks at half speed
  block_motor_done(2); //waits until position moves are completed
}
```

# Timing Vs. BEMF Worksheet

Group # \_\_\_\_\_

Start Time: \_\_\_\_\_

End Time: \_\_\_\_\_

Record distance robot is from the target position after each run.

Run	BEMF	Timing
#1		
#2		
#3		
#4		
#5		
Average		

Did you use Demobot or build your own robot?

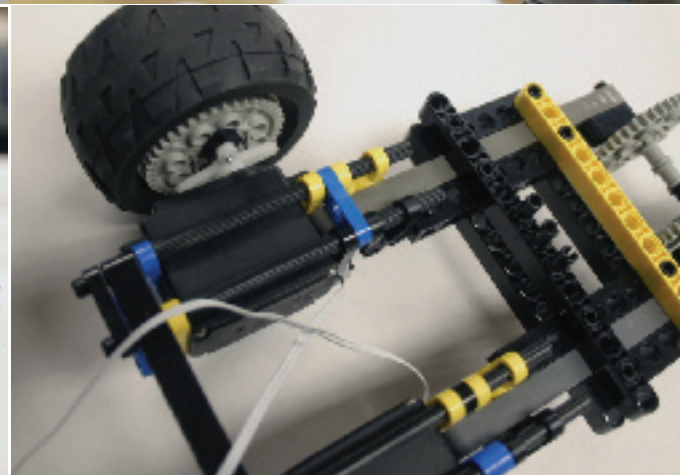
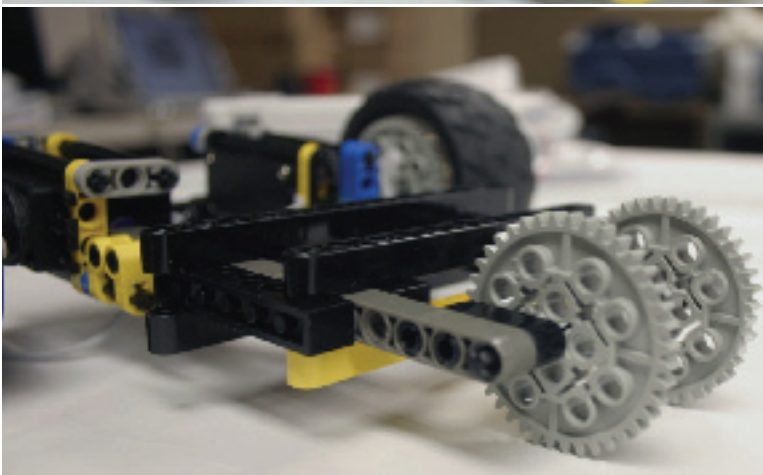
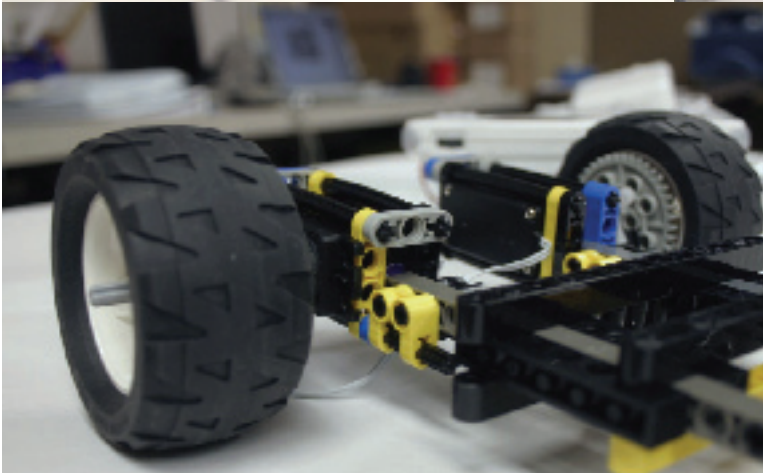
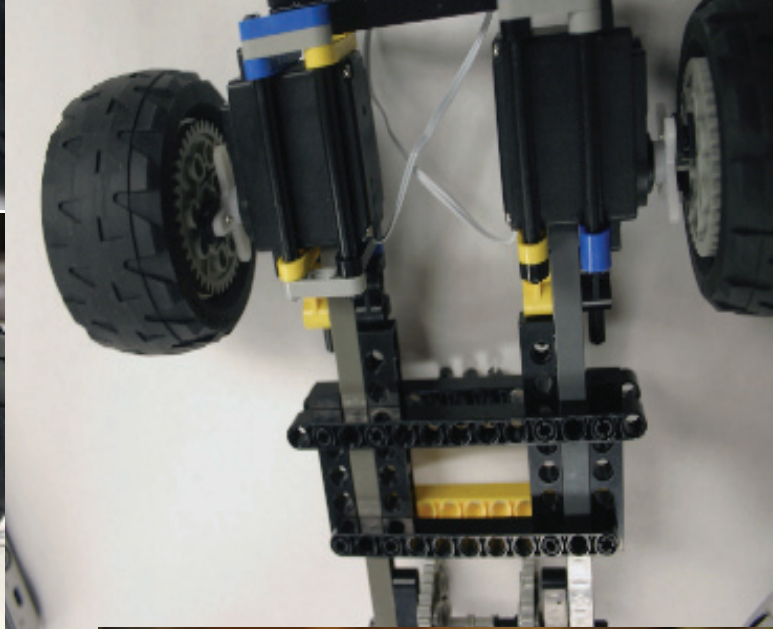
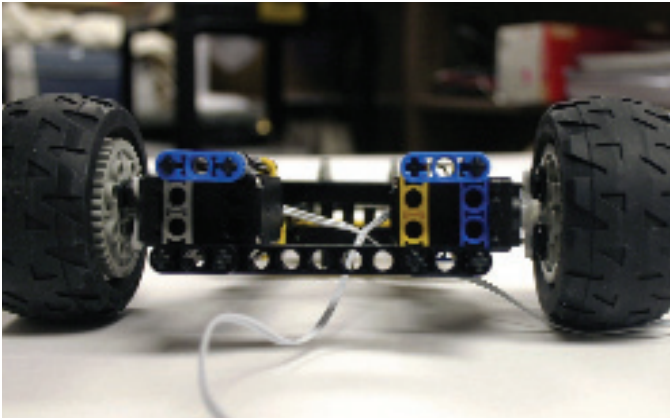
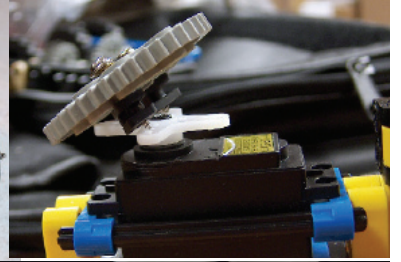
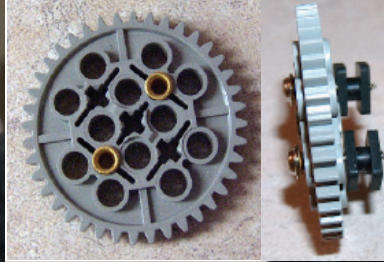
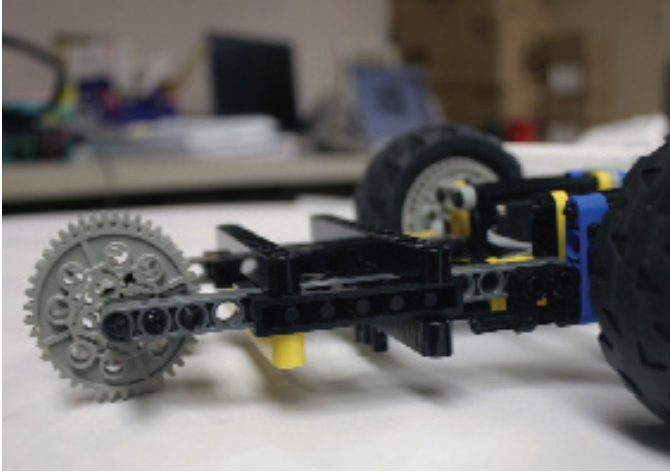
How did you get your robot to travel straight?

Which program was more accurate? Why?

What problems did you encounter and how did you solve them?

# Sample Robot

Attaching the Gear to the Black Motor



Sample Robot Page 2

