

Introduction

- Collective behavior of individual agents is observed in various aspects of everyday life, for example in flocks of birds, schools of fish, herds of animals, or the crowds and car traffic.
- In many cases, when agents try to collectively exit a bottleneck, they encounter clogging.
- In this research, we study clogging by observing the movement of a set of programmed robots.
- The concept of clogging will be investigated in three steps:
 - Firstly, to understand how varying relative motor rotations changes the overall collective motion.
 - Secondly, to vary the interactions between identically programmed bots.
 - Thirdly, to study the collective behavior of multiple bots under different bottleneck geometries
- This poster only represents the first step of this research by investigating the relationship between bot's program change and its speed change

Method

- Programmable-bots are composed of:

- 2 x Servo Motors
- A nano Arduino
- 4 x Batteries AAA
- A batteries holder
- 4 x wheel tracks
- A breadboard



Fig. 1. The programmable Bot

- Bots are programmed by changing servo speeds (between 0 and 180) using Arduino. 0 speed is full forward, 90 is close to zero, and 180 is full reverse
- Plywood was used to create the boundaries and bottleneck for the system.
- To track the movement of bots, a camera was placed above the system.



Fig. 2: Experiment setup

Data Interpretation

- The movement of bots was analyzed by using custom python's object tracking program.



Fig. 3. Position of bot with program 0x180 at time t = 60 frames (2 secs)

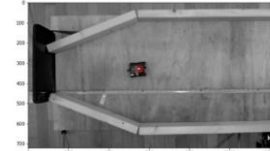


Fig. 4. Position of bot with program 20x160 at time t = 60 frames (2 secs)



Fig. 5. Position of bot with program 40x140 at time t = 60 frames (2 secs)



Fig. 6. Position of bot with program 50x130 at time t = 60 frames (2 secs)

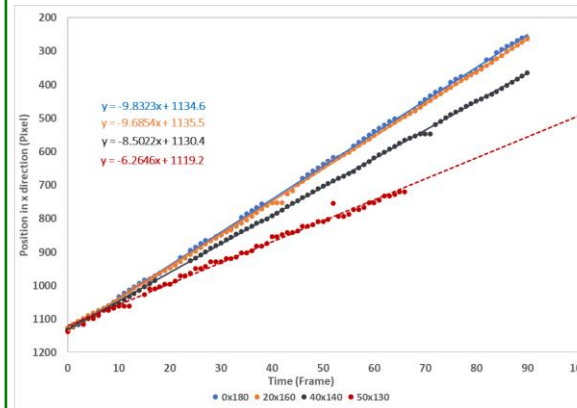


Fig. 7. Graphical analysis of the bot with each program.

- Based on the figure 7, the speed of the bot in each trial is determined by finding the slope of the graph.

Conclusion

- The speed of the bot in pixel/frame and m/s (1 pixel/frame = 0.032 m/s)

Program	Speed	
	Pixel/Frame	m/s
0x180	9.832	0.324
20x160	9.685	0.320
40x140	8.502	0.281
50x130	6.265	0.207

- From the preliminary results, it indicated that the speed of bot decreases when the program of servo goes to 90.
- By investigating the relation between the change of program and the change of speed of the bots, we have developed a platform to study the interactions between identically programmed bots, as well as the collective behavior of multiple bots under different bottleneck geometries.

References

- G.A. Patterson, Clogging Transition of Vibration-Driven Vehicles Passing through Constrictions, [PRL 119, 248301 \(2017\)](#)