Minimizing Collisions on a Singulator

Caroline Perret

College Park Scholars – Science & Global Change Program
Mathematics: Statistics and Computer Science
cperret@terpmail.umd.edu
CPSG 240
College Park Scholars Academic Showcase, May 3, 2024

Introduction

The Singulator conveyor belt takes 4 lanes of scrambled packages and produces a single file line. It does this by splitting into 2 lanes and speeding the right lane up while leaving the left side behind. This staggers the packages so then they can be sent diagonally to the center of the belt, separated from each other. Figure A displays how the packages move when they are all in a row when entering the Singulator. Figure B displays an example of a collision risk on the Singulator, showing how they catch each other once they enter the discharge zone.

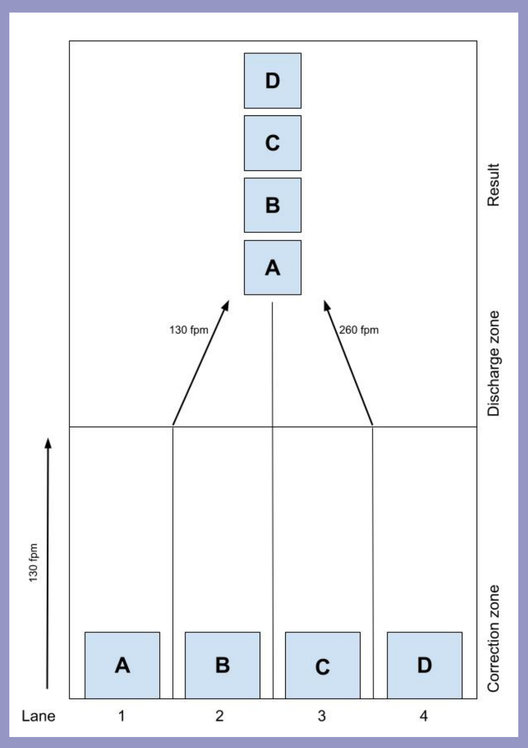

Figure A

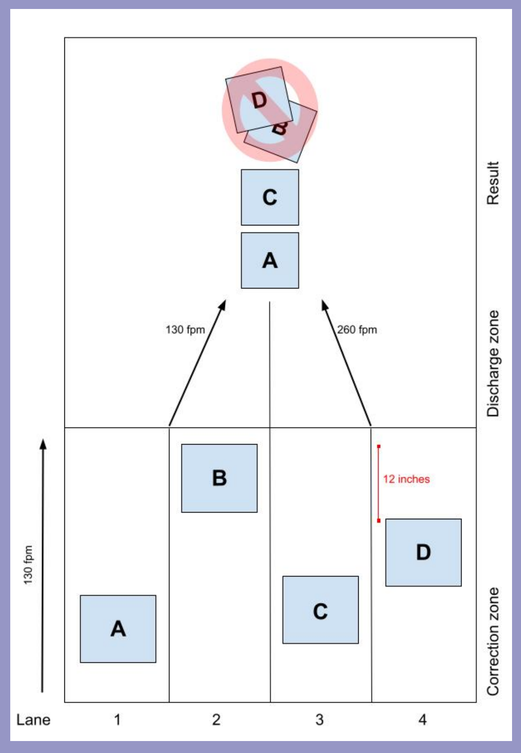

Figure B

Issues Confronting Site:

Due to the differing speeds of the lanes and the direction they are sent in in the discharge zone, there are several situations where smaller packages such as poly bags and envelopes collide on the belt. It's been found that when a small package to the left of another is about 6 inches ahead, as they enter the discharge zone they will come to the center at the same spot and stack.

I was tasked with coming up with an algorithm to analyze the package scenario and adjust the speed of the lanes so that the collision risk would be avoided.

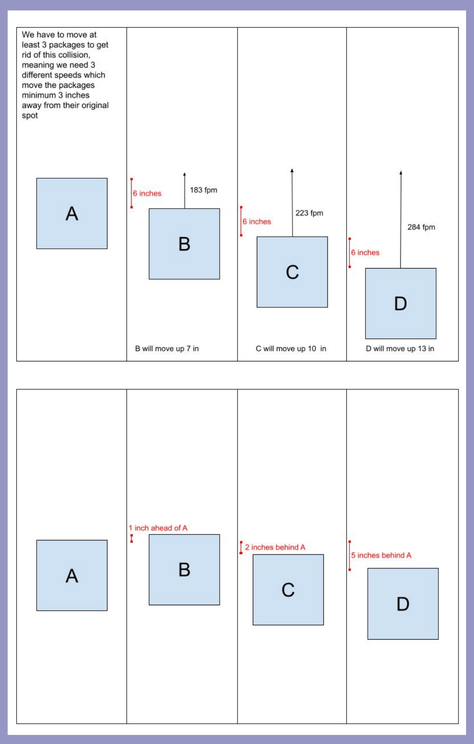

Figure C

Activities:

I created several equations for this specific scenario. One that I found useful was an equation for what I refer to as 'bystander packages.' These were packages next to or behind a package which was getting sped up to fix a collision risk, which also got sped up. This was an issue because this could cause additional collisions, so they had to be considered. I created an equation which would tell you how far the package would be shifted based on the baseline speed, the adjusted speed, and the amount of time at the adjusted speed.

I also came up with several solutions to solve specific collisions. One example of a solution I came up with is depicted in figure C. You can see the speed adjustments when the enter the correction zone. In figure D, you can see the layout of the Singulator.

Impact:

This conveyor belt is used by Amazon, and upwards of 500 packages are expected to run through it each minute. This makes collision risks common and important to avoid or fix while the machine is running. The several solutions I came up with can be coded together to prevent as many collisions as possible, so less humans are needed to correct the packages on the belts. This makes the machines more efficient and profitable for Impact Automation.

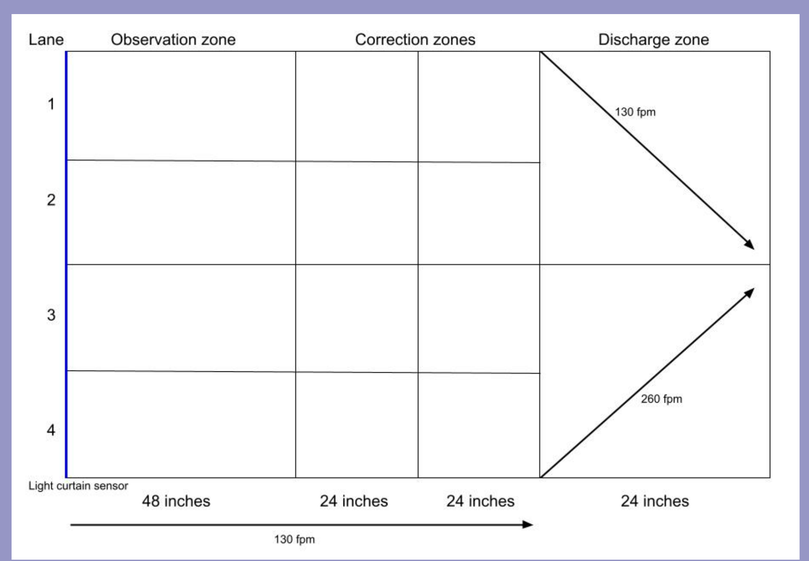

Figure D

Site Information:

Impact Automation

9305 Gerwig Ln suite t, Columbia, MD 21046

Supervisor: Steve Wargo

Site mission: Provide top notch conveyors, automation, and sorting solutions.

Goals of the site: Upgrade the existing Singulator machine to avoid package collisions.

Future Work:

Another approach to this problem is utilizing gradient descent algorithms and artificial intelligence. If you could create an equation for the amount of collision risks present while the packages are in the observation zone and maximize the equation so that as many collisions as possible are avoided.

Acknowledgments:

I would like to thank Steve Wargo for reaching out to me to work on this algorithm and welcoming me into his company this August. I would also like to thank Dr. Holtz and Dr. Merck for their instruction during my time as a College Park Scholar.