Engineering Portfolio

Cooper Cole

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SpinStop

Aug 2023 - Present

- Increasing safety and efficiency of helicopter rescue operations by designing a mechatronics system to stop the uncontrolled spinning of helicopter hoisted payloads.
- Co-founder on a team of 4.
- Contributing to the wireless data collection and display system, encompassing firmware and website development, as well as outreach for industry partners and grant funding
- Successfully secured over $1k in funding, sponsorships, and industry partnerships for the project

The Problem
During helicopter rescue operations, environmental factors such as wind and rotor downwash can cause the rescuer or the rescue subject to spin uncontrollably while being hoisted. Rescuers often suffer wrist and ankle injuries in trying to stabilize themselves if they touch down while spinning. Excessive spinning can cause nausea and dizziness which is especially dangerous for a rescue subject who is already in a vulnerable state. Presently there is no solution to stop the uncontrolled spinning of all rescue payloads in all scenarios. Only best practices exist to avoid spinning. The spinning of the helicopter hoisted payload adds extra complexity and time to each rescue mission, while also posing an injury hazard to rescue operators and subjects.

Our Solution

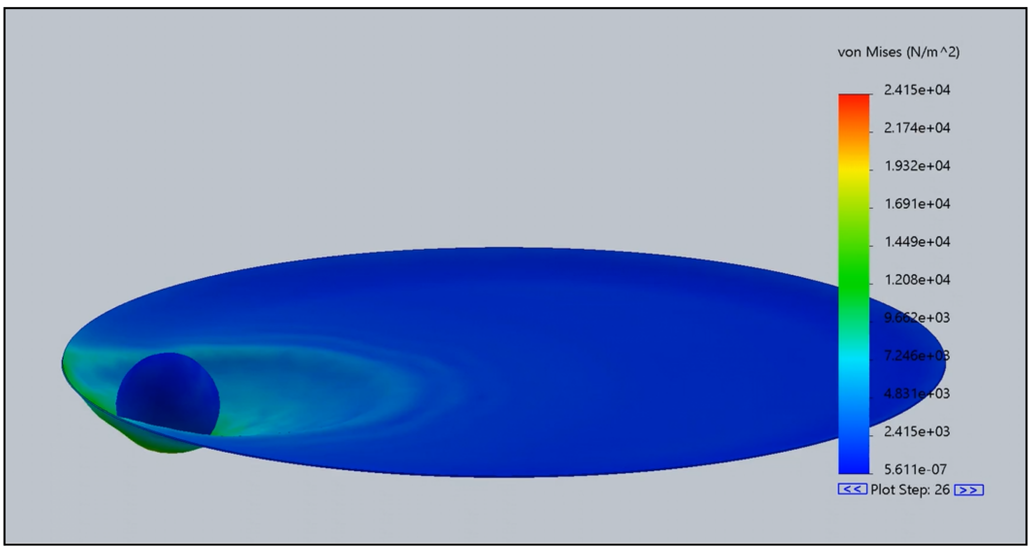
Our design connects the rescue payload to the helicopter hoist cable via an intermediary system that can detect when the payload starts spinning, and apply an appropriate torque to the payload to stop its spin. Being an intermediary system, it can have the appropriate mechanical interface to connect to any existing helicopter cables and any rescue payloads, allowing it to be easily added and removed without having to change existing helicopter systems.

Checkout https://spinstop.ca/ for more.

Spikeball Net Model

Oct 2023 - Present

- Part of a 3-person team to create and validate an FEA model of Spikeball ball-net interaction, with a focus on “Pocket Shots”
- Validated the model by comparing it to experimental data measured using openCV ball tracking software
- Results pending



Steel Billet Exchange Assembly

Apr 2022

The objective of this project was to design a table for pallets of steel billets to be exchanged with an automation robot cell on a manufacturing line; the table must interface with pre-existing pallet carts and pallets and meet ANSI/ISO safety standards for manufacturing lines. From this objective, the table was designed around the dimensional constraints of the pre-existing pallet carts and part pallets.

The precision welding and large-scale machining required to meet the dimensional constraints set by the pallet carts was not available. Thus, the greatest challenge was designing the assembly with parts that can be easily fabricated by the in-house machinists, while staying within the dimensional constraints and avoiding tolerance stack up. This was overcome by using datum pins to ensure position repeatability and adding adjustability to position critical parts using slot holes.

The assembly contains over 50 unique commercial parts and 40 unique custom parts designed in SolidWorks. The design is easily fabricated with stock dimensioned materials and meets ANSI/ISO safety standards for automated manufacturing lines The final design achieves the objective and meets the constraints and criteria outlined in the objective statement. See Figures below.

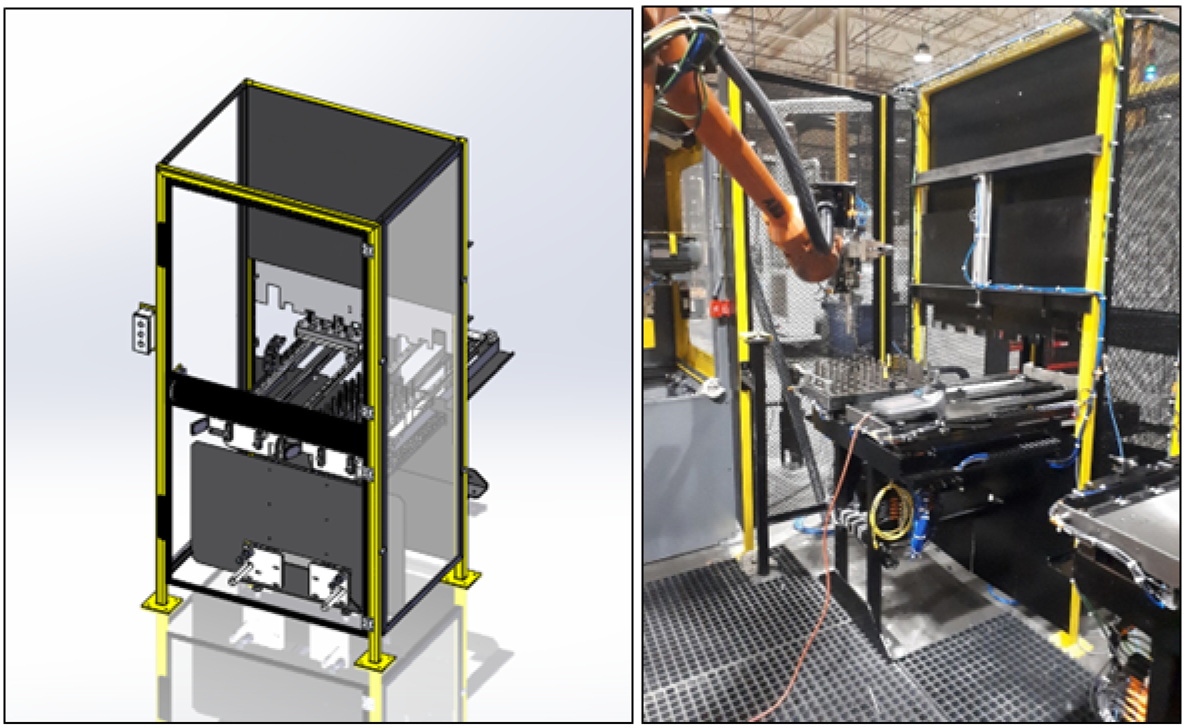


Figure 1: Steel Billet Exchange Assembly

Figure 2: Steel Billet Exchange Assembly Rear View

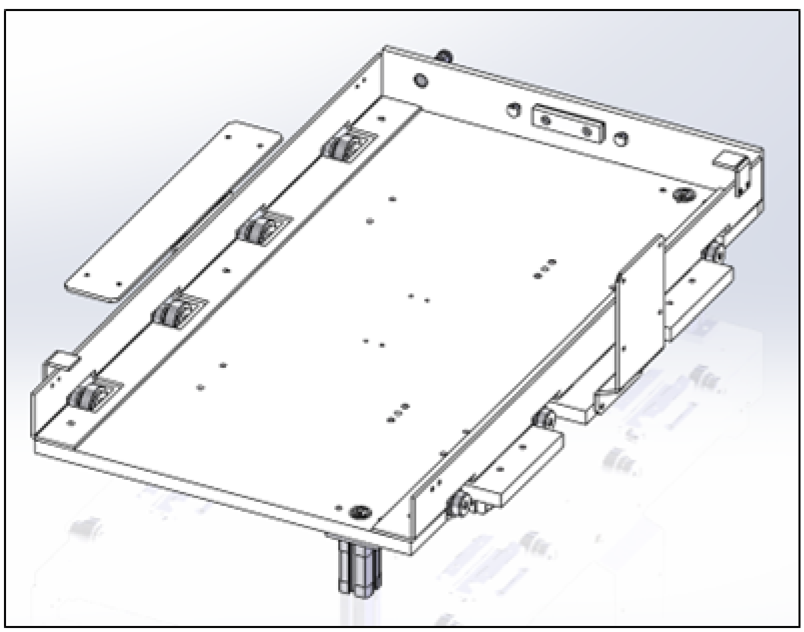


Figure 3: Pallet Dolly

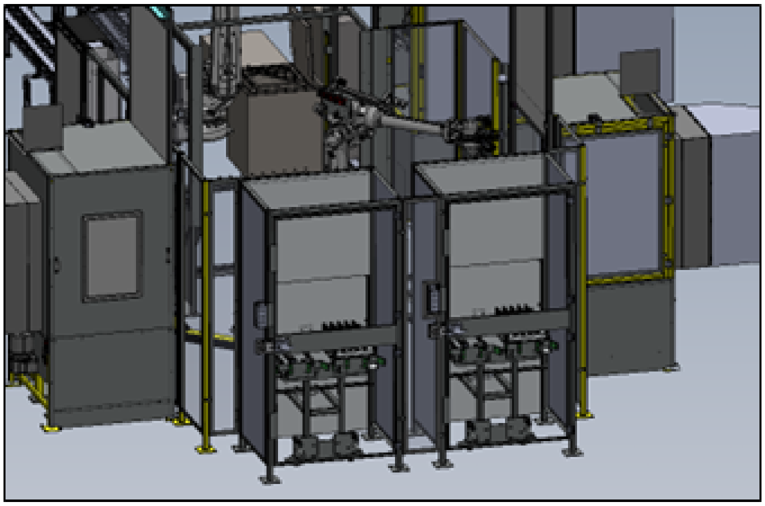


Figure 4: Automation Cell Model

Figure 5: Automation Cell Front View

Robot Cell Part Nest

Apr 2022

Redesigned the factory's standard robot cell part nest using SolidWorks to improve manufacturability, cut material cost and reduce assembly time by 50%. Purchased the necessary sensors, assembled the nest, and programmed the robots automated manufacturing routine to use it. The greatest challenge is simplifying parts for easier manufacturing while maintaining the position of the spigots. This was done by combining two or more parts into one and using datum pins. See Figure 6.

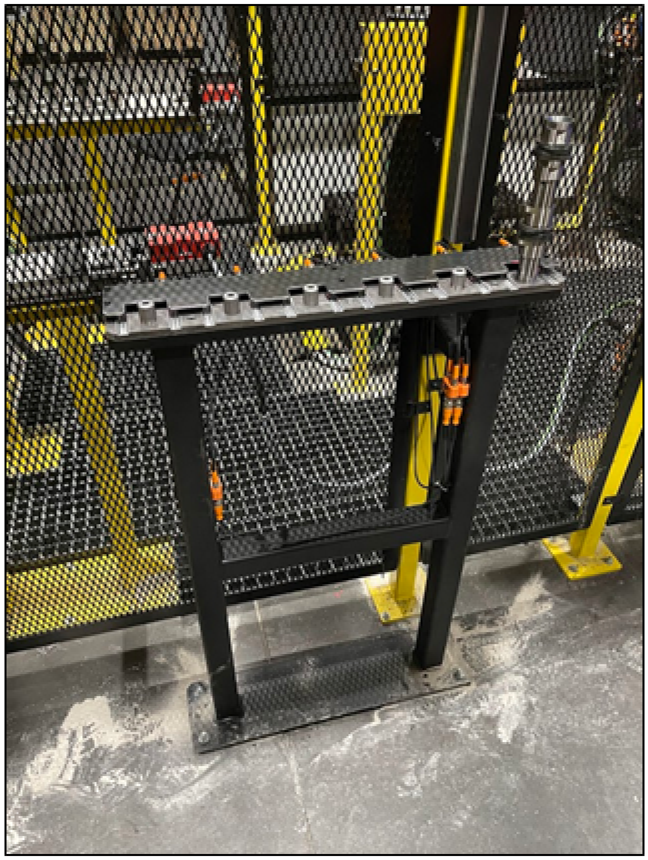


Figure 6: Robot Cell Part Reject Nest

Autonomous Checkers Robot

Fall 2019

As part of a first-year engineering design course, myself and 2 classmates were tasked to build a mechatronic system using Tetrix and Lego EV3 Mindstorms.
Our team constructed and programmed a robot to play an entire game of checkers against itself. Built with a 3-axis movement system and gripper built with Tetrix and Lego Mindstorms. The controller was programmed in C with an original checkers algorithm. The project took 1 month to research, design, build, and test the system.
The biggest challenge was for the 3-axis movement system to be precise and repeatable. Using gears and rack and pinion, the movement system was precise enough to move to each spot on the board, pick up a piece and move it to the desired location. As for repeatability, the location of the gripper was stored and updated in the software. The location was updated each time it

stopped at a square on the board, due to mechanical imperfections, the location error would build up. To fix this, buttons were placed on the robot that would update the location of the gripper in software to the actual physical location. Each time the robot moved to the zero location in the x or y axis, the button on the robot would be pressed by the frame, updating the location, and eliminating error.
See Figure 7. And check out the demo video.

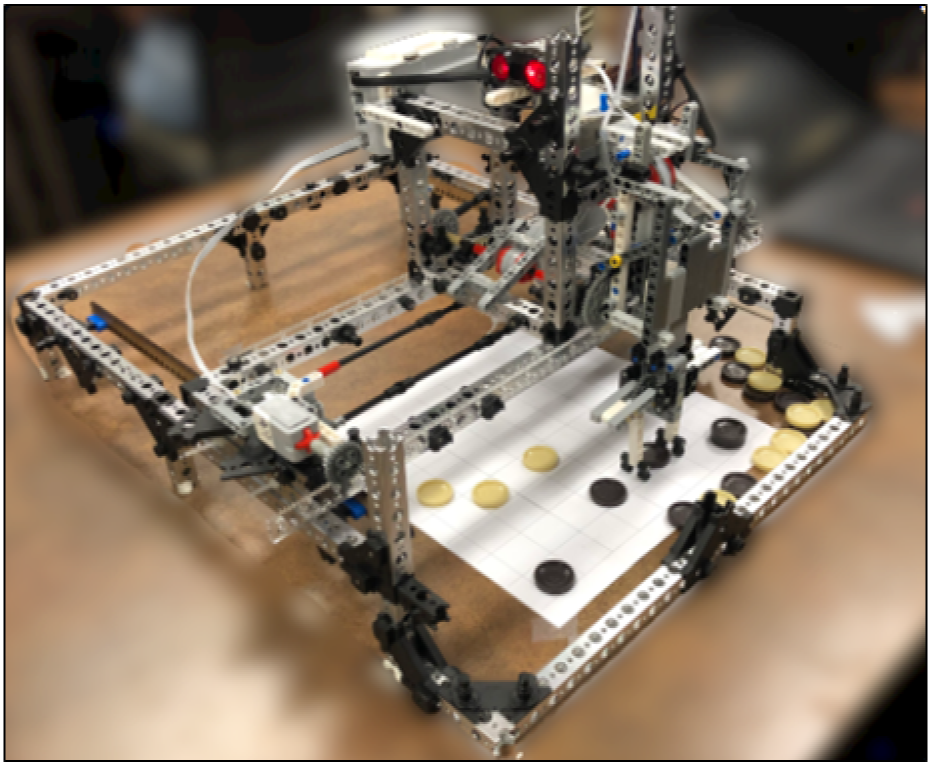


Figure 7: Autonomous Checkers Robot

Website Development

I have done a bit of web dev for myself and some projects. I am a fan of lightweight websites with simple and clean designs. Check them out below.
https://coopercole.ca/
https://spinstop.ca/
https://engnews.ca/

Relevant Coursework

Studying mechatronics engineering, I get to learn a multidisciplinary blend of topics, from mechanical and electrical design to computer programming and automation technology. Through my courses, I have learned technical skills in CAD, Design, Programming, and more.

Relevant Courses include:

ECE 484 Digital Control Applications
Dynamic system modeling: linear, nonlinear, state-space, sample data systems, computer simulation, system identification. Discrete system stability and dynamic performance. Nonlinear system analysis, limit cycles. Digital control system design: emulation methods, z-domain, frequency domain, pole placement. Implementation of digital controllers. Laboratory projects in computer control of mechatronic and other systems.

SYDE 575 Image Processing
Beginning with a discussion of quantitative models of imaging systems, this course moves on to apply methods of linear systems theory and signal processing to image processing. Simple spatial domain techniques as well as spatial frequency domain methods, and digital filter design for image enhancement and restoration are discussed. The key methods and problems are surveyed; edge detection, image denoising, image segmentation, image enhancement, image compression, image registration, and feature detection. Applications to machine vision, remote sensing, and medical imaging will be emphasized.

BME 550 Sports Engineering
This course focuses on the application of engineering principles to the analysis of sports equipment and their effects on athletic performance. Principles of mechanics are used to understand the motion and forces arising in sports equipment, and their interaction with the musculoskeletal dynamics of athletes.

MTE 325 Microprocessor Systems and Interfacing for Mechatronics Engineering
Synchronization and data flow; interfacing to sensors and actuators; microprocessor system architecture, parallel, serial, and analog interfacing; buses; direct memory access (DMA); interfacing considerations.

MTE 360 Automatic Control Systems
Feedback control design and analysis for linear dynamic systems with emphasis on mechanical engineering applications; transient and frequency response; stability; system performance; control modes; state space techniques; Introduction to digital control systems.