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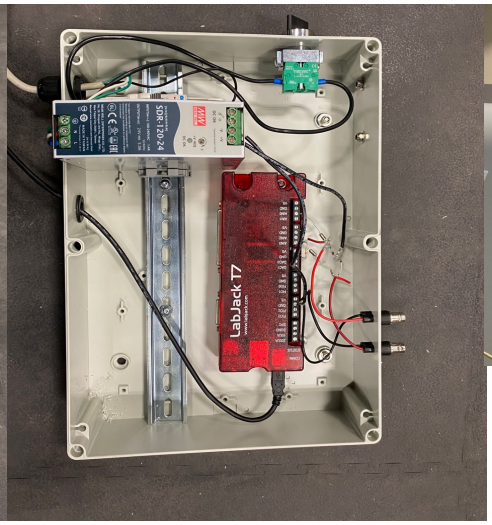
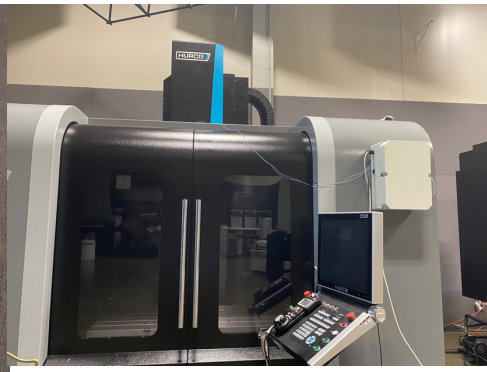
Machining Vibration Measurement System





Project

- Designed and constructed a vibration measurement system for real-time chatter detection in CNC machines.
- Recorded measured vibrations to gather data to train a recurrent neural network to detect chatter.

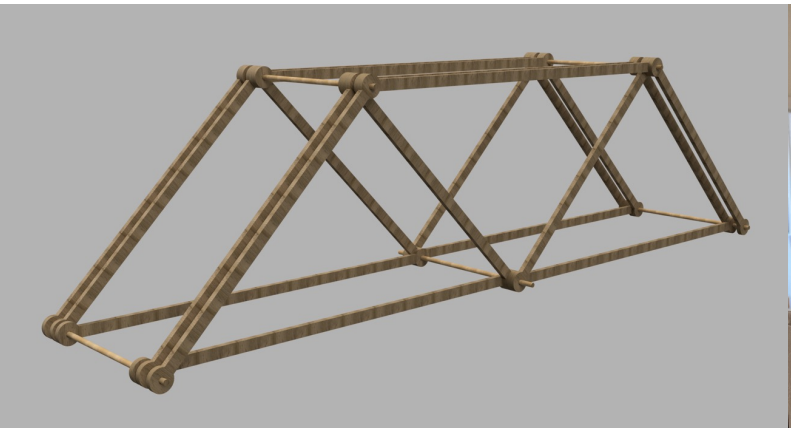
Implementation

- Created a signal conditioning circuit to take input from miniature piezoelectric accelerometers.
- Applied lowpass filters to acceleration signals before plotting as a Poincaré section and calculating chatter indicator values.

Results

- By sending commands via EtherCAT and halting machining operations during chatter, machine tool lifespan increased up to 50%.
- Chatter detection data and measured accelerations from the system were incorporated as ground truths in the research paper *Transfer Learning for Three-Axis CNC Anomaly Detection in an Industrial Machine Shop*, currently under peer review.

Laser Cut Truss Bridge



Project

- Designed a truss bridge from balsa wood and dowels to withstand as much weight as possible before fracture.
- Tested balsa wood samples to obtain data to plot a stress-strain curve and calculate theoretical performance in MATLAB.

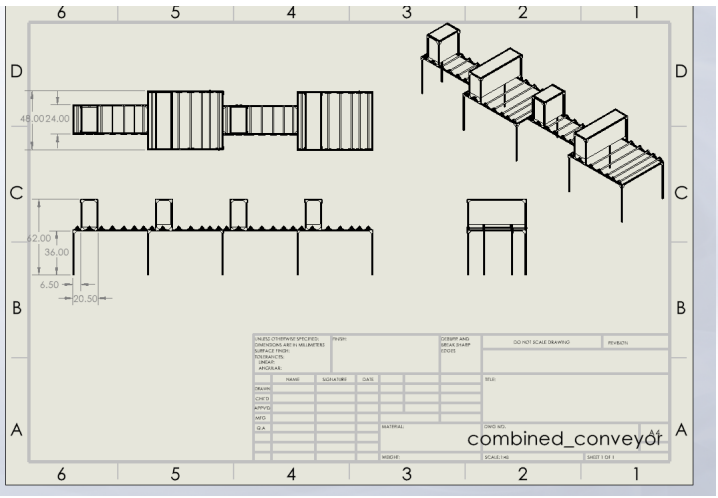
Implementation

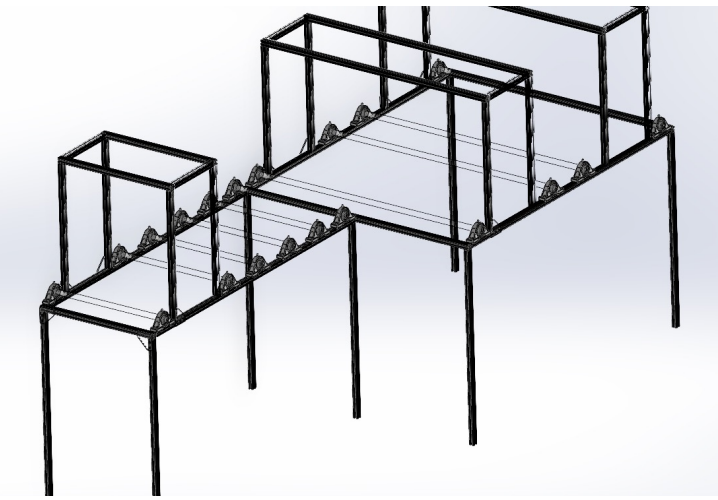
- Modeled bridge components in Fusion 360 to produce renders and performed static stress analysis in MATLAB to validate design and predict ultimate strength of bridge.
- Used AutoCAD to create technical drawings conforming to GD&T of bridge components, which were then laser cut by a local machine shop.
- Redesigned components to improve tolerances and allow for a glue-free assembly with interference fits.

Results

- Bridge held up more than 400 times its own weight before fracturing and achieved 4th place overall in a class competition involving 30 different teams.
- Predicted ultimate strength of bridge was within 20% of actual value, with the predicted value being greater.

Conveyor Belt Design Project





Project

- Designed a self-sorting conveyor system and sourced components from McMaster-Carr to meet requirements of moving items 2 meters away and sorting items using sensor data.
- Justified design decisions, including parts sourced, software implemented, and sensors used.

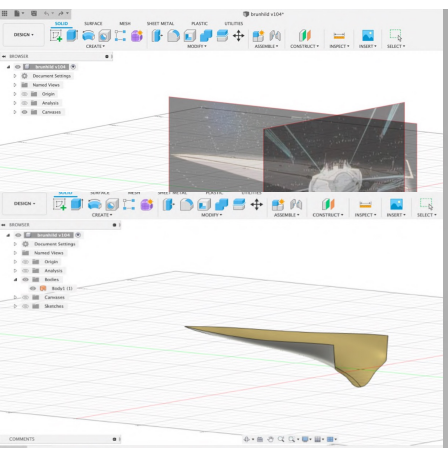
Implementation

- Created assemblies, CAD drawings, and 3D simulations in SolidWorks.
- Produced and justified decision matrices for sensor choices and performed cost-benefit analysis for physical components.
- Implemented custom Canny edge detector in MATLAB.

Results

- Successfully implemented sorting algorithm for boxes that covered all use-cases.
- Determined the orientation of boxes on the conveyor belt to within 10◦, achieving nearly 97% accuracy.

Brunhild Model Spaceship



Project

- Created a recognizable CAD model of a fictional spaceship in Fusion 360 and optimized design for 3D printing.

Implementation

- Assembled frames from the anime that the Brunhild spaceship is from as reference images to aid in modelling and ensure a recognizable model in the end.
- Used surface modelling to form meshes, then stitched together meshes to form solid bodies that were combined with conventional solid modelling to form complex and aesthetically pleasing shapes.
- Redesigned components to improve tolerances and allow for a glue-free assembly with interference fits.

Results

- Printed the final model using a Creality Ender 3 and as 8 separate pieces and then assembled these together to get a physical representation of the model.