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ILLINOIS INSTITUTE OF TECHNOLOGY

Transforming Lives. Inventing the Future.

Design of a Simulator for Mechanical Loading of Garage Door Operator Systems over a Wide Temperature Range

IPRO 324 – Fall 2003

Our Sponsor: Chamberlain

CHAMBERLAIN®

- World's largest manufacturer of residential garage door operator systems.
- Exclusive provider of all garage door operators for SEARS

Problem Definition

- Chamberlain guarantees their garage door operator systems to last for approximately 25,000 cycles (10 yrs.) in all weather and environmental conditions.
- Need of in-lab testing data to ensure this warranty.
- Chamberlain's current weight based system in their environmental chamber (THERMOTRON) over estimates life span of garage door operators.
- PROBLEM: Build a simulator that closely approximates real garage door operator life span taking into consideration size constraints in the THERMOTRON.

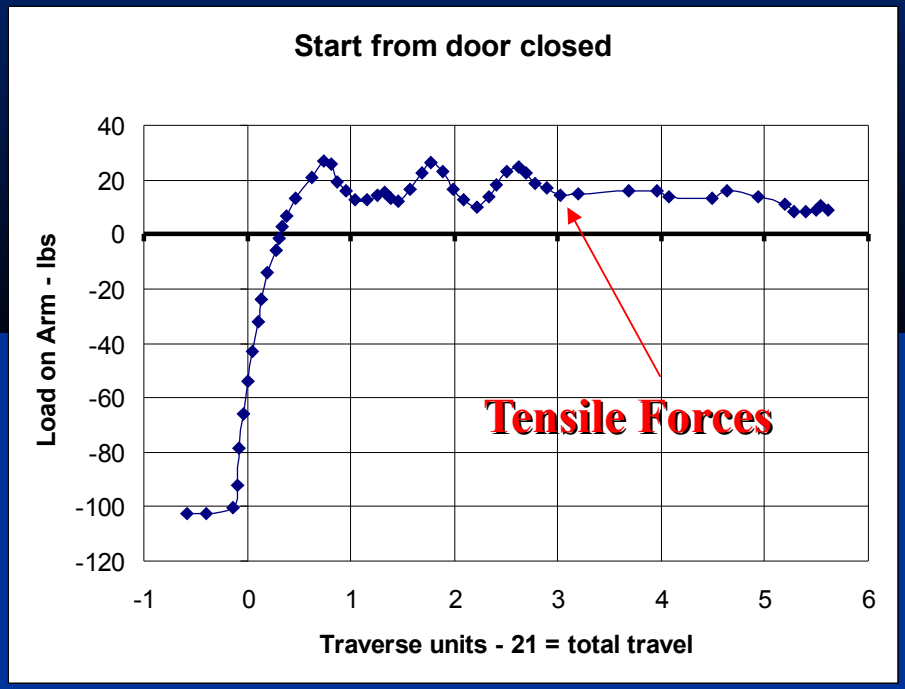
THERMOTRON

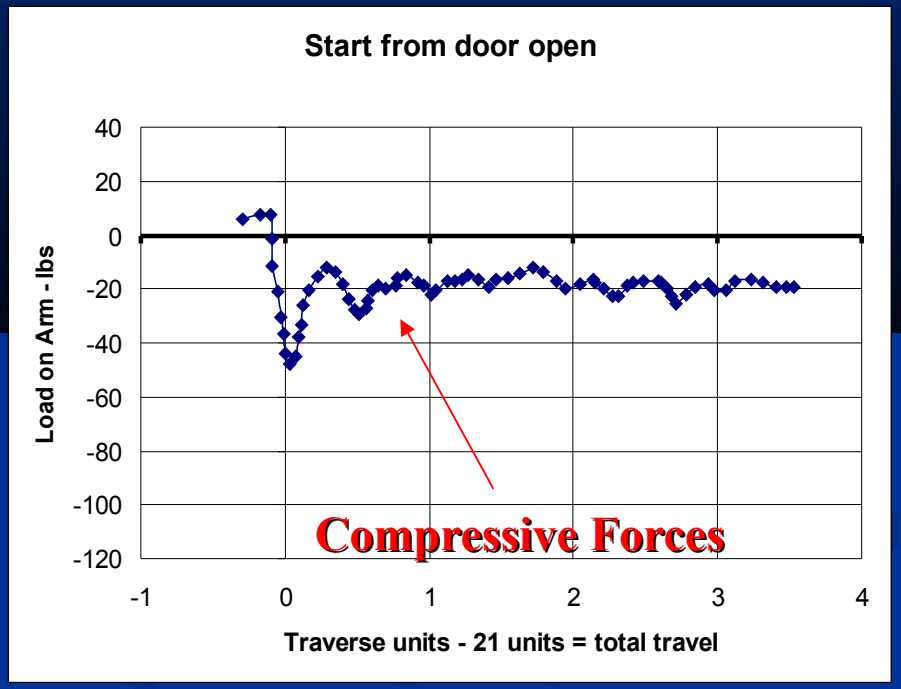
Inner Dimensions: 4’ x 7’ x 14’

Problem Solving Approach

- DATA COLLECTION
- DESIGN CONCEPTS
- SIMULATOR IMPLEMENTATION

Data Collection

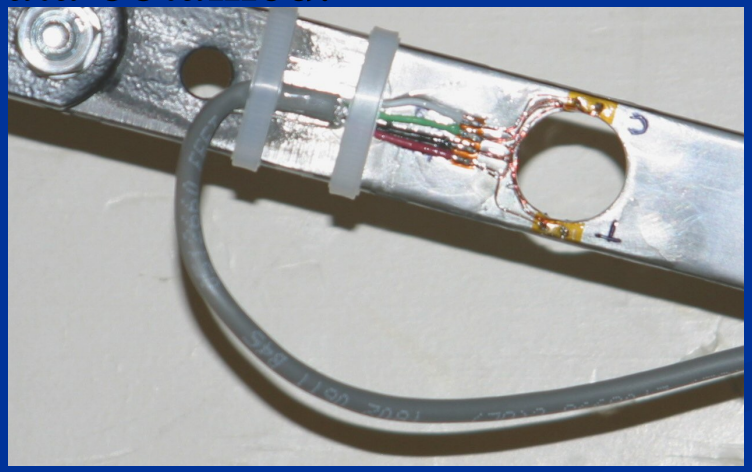




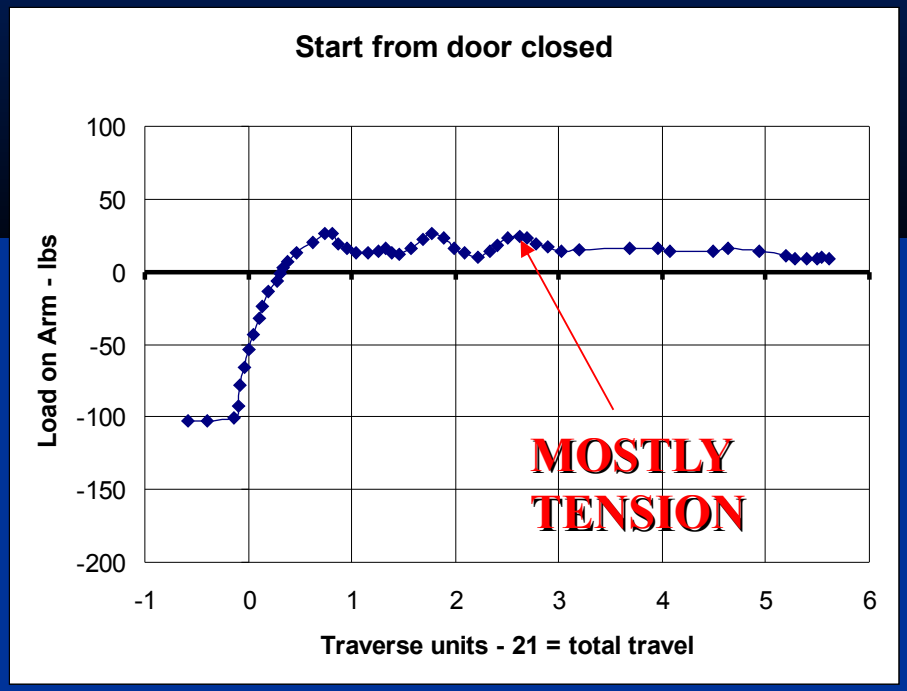
- Chamberlain provided load profiles of garage door operator arm.
- Opening cycle: Tension Forces predominate
- Closing cycle: Compression Forces predominate

Data Collection

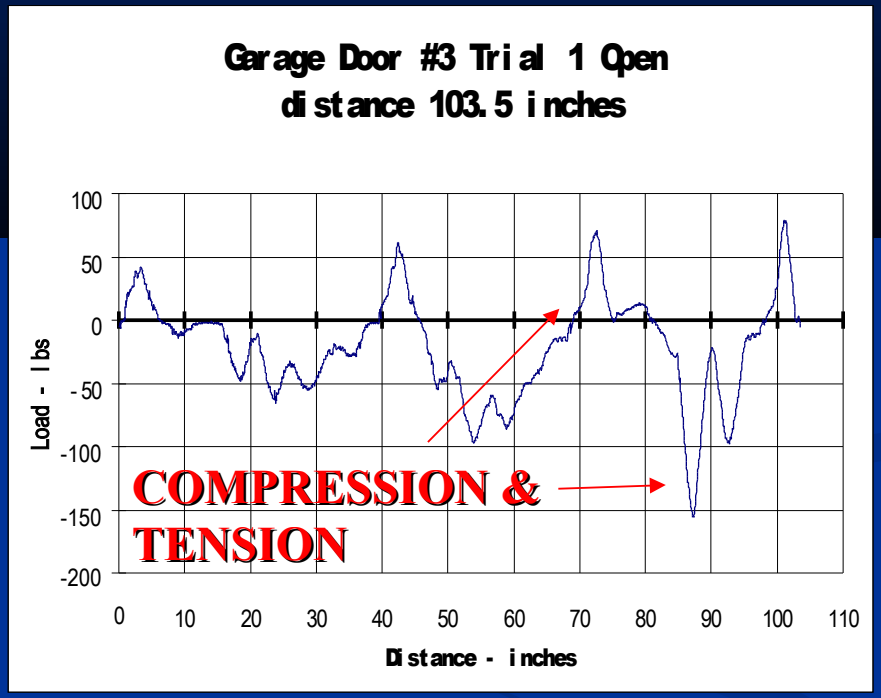
- Design of our strain gauge arm to collect our own data.
- New load profiles were collected during two trips to Chamberlain.
- Initial data differed from new data obtained.



Data Collection: Our data vs. Chamberlain's



Chamberlain's Data

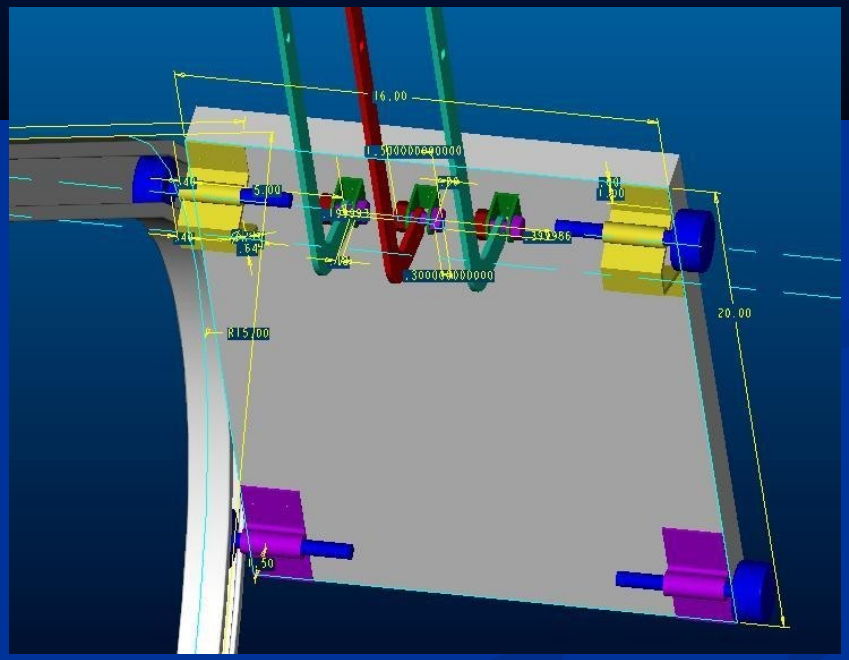


IPRO 324 Data

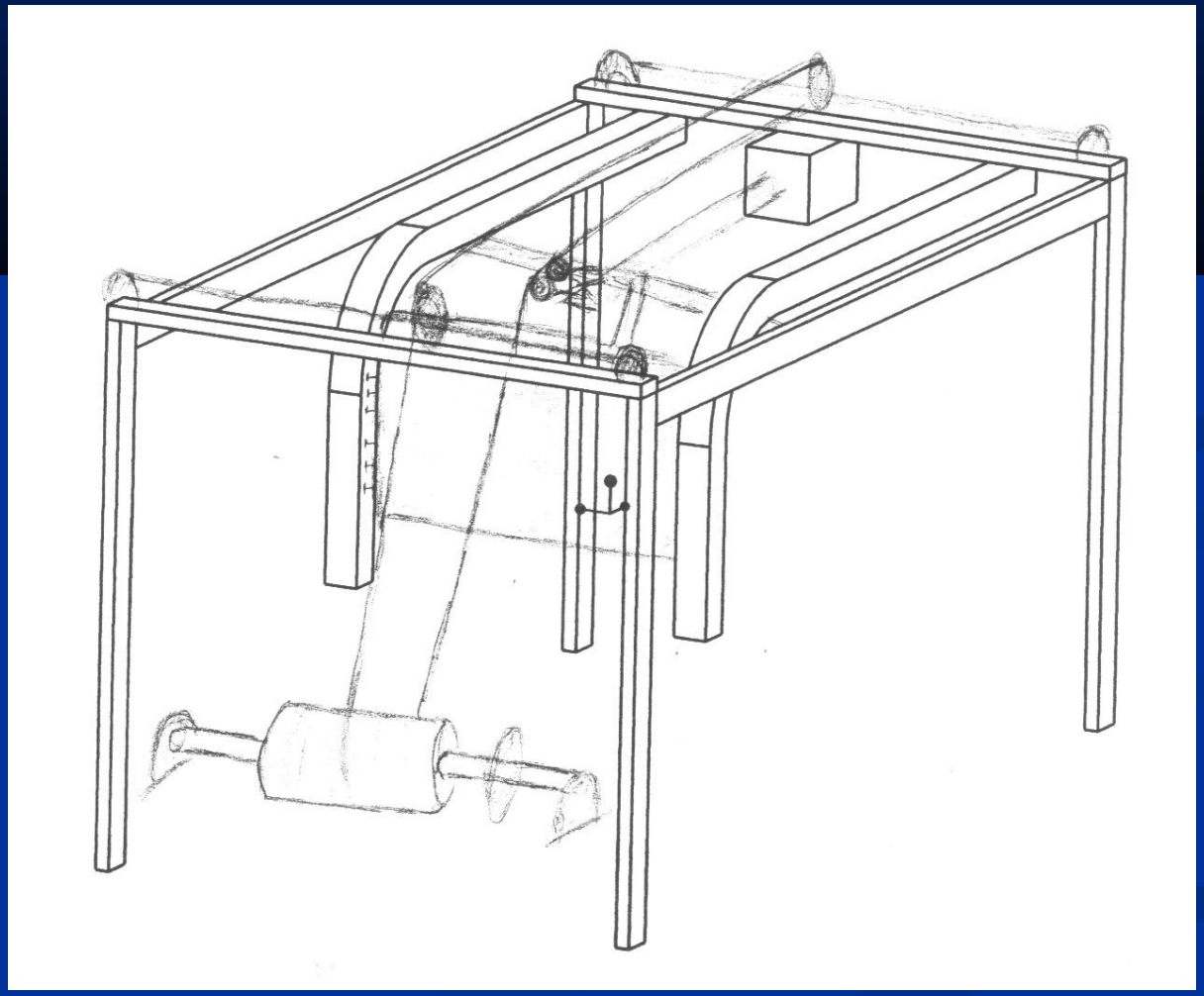
Design Concepts

Design concepts:

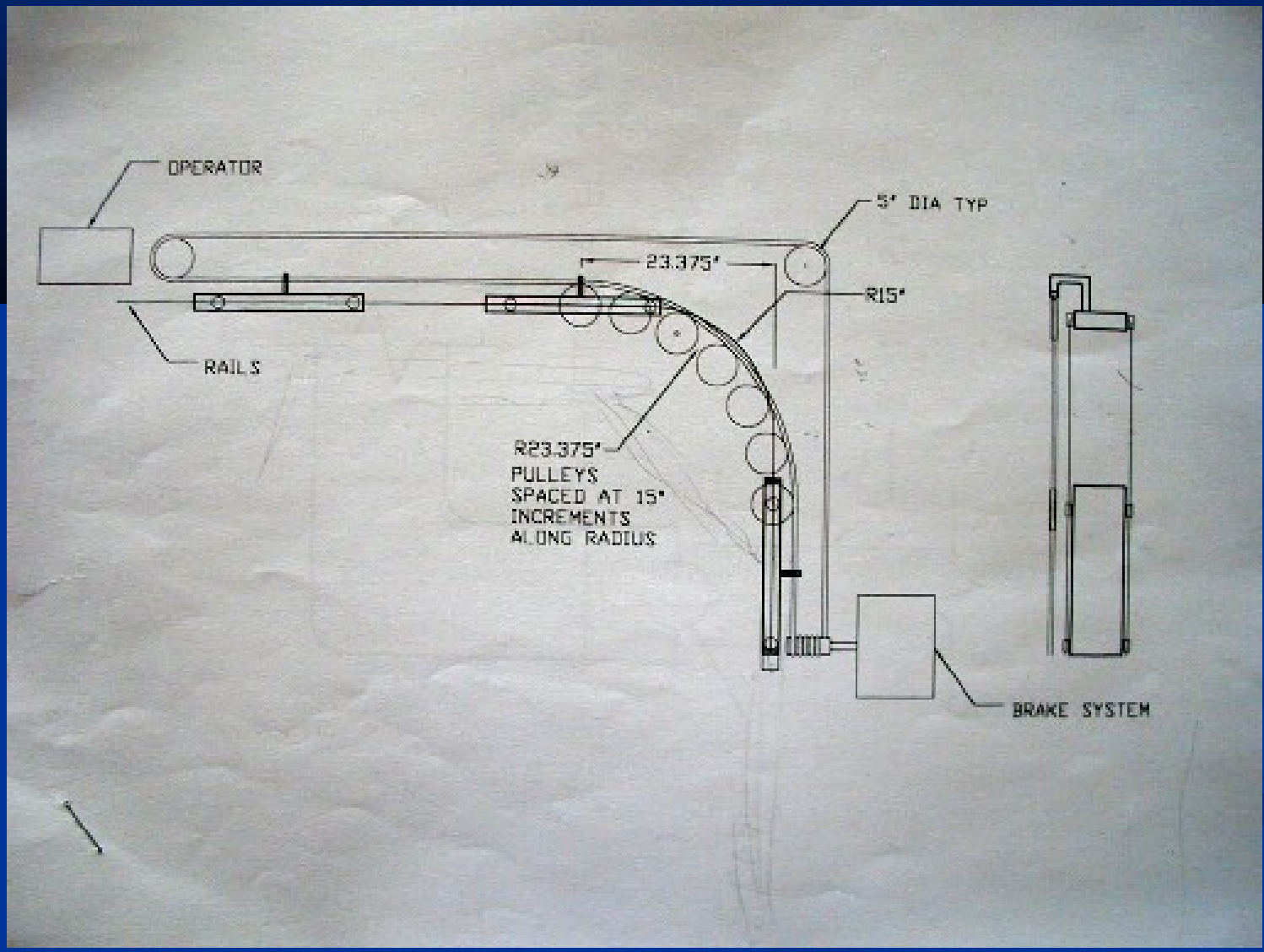
- Pulley System
- Ski Lift System
- Two-Rail System



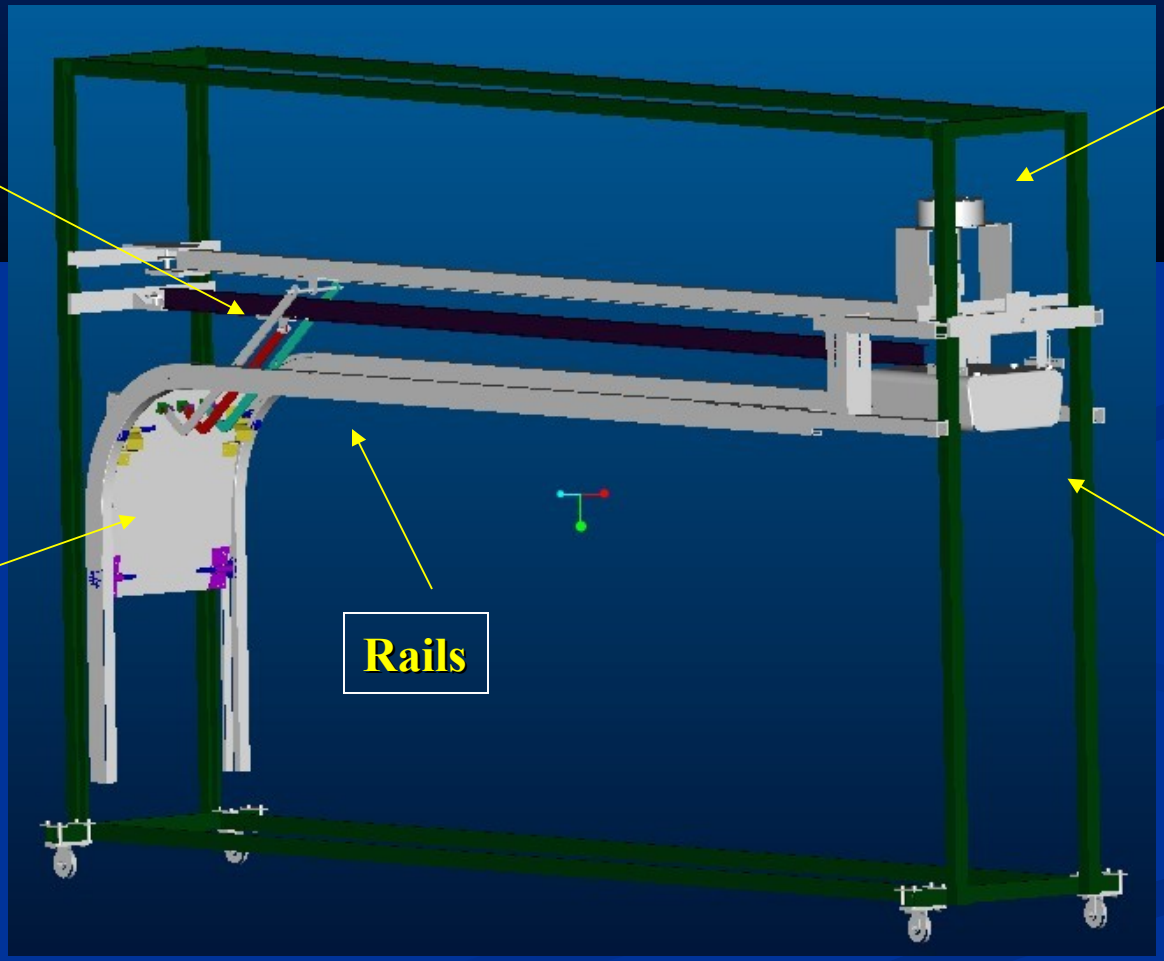
Design Concepts: Pulley System



Design Concepts: Ski Lift



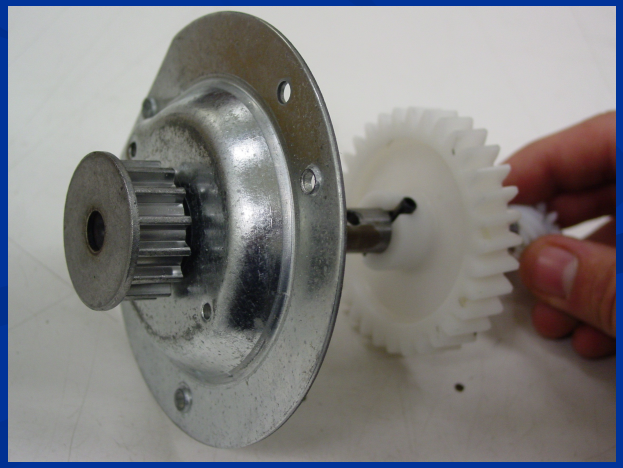
Current Simulator Implementation



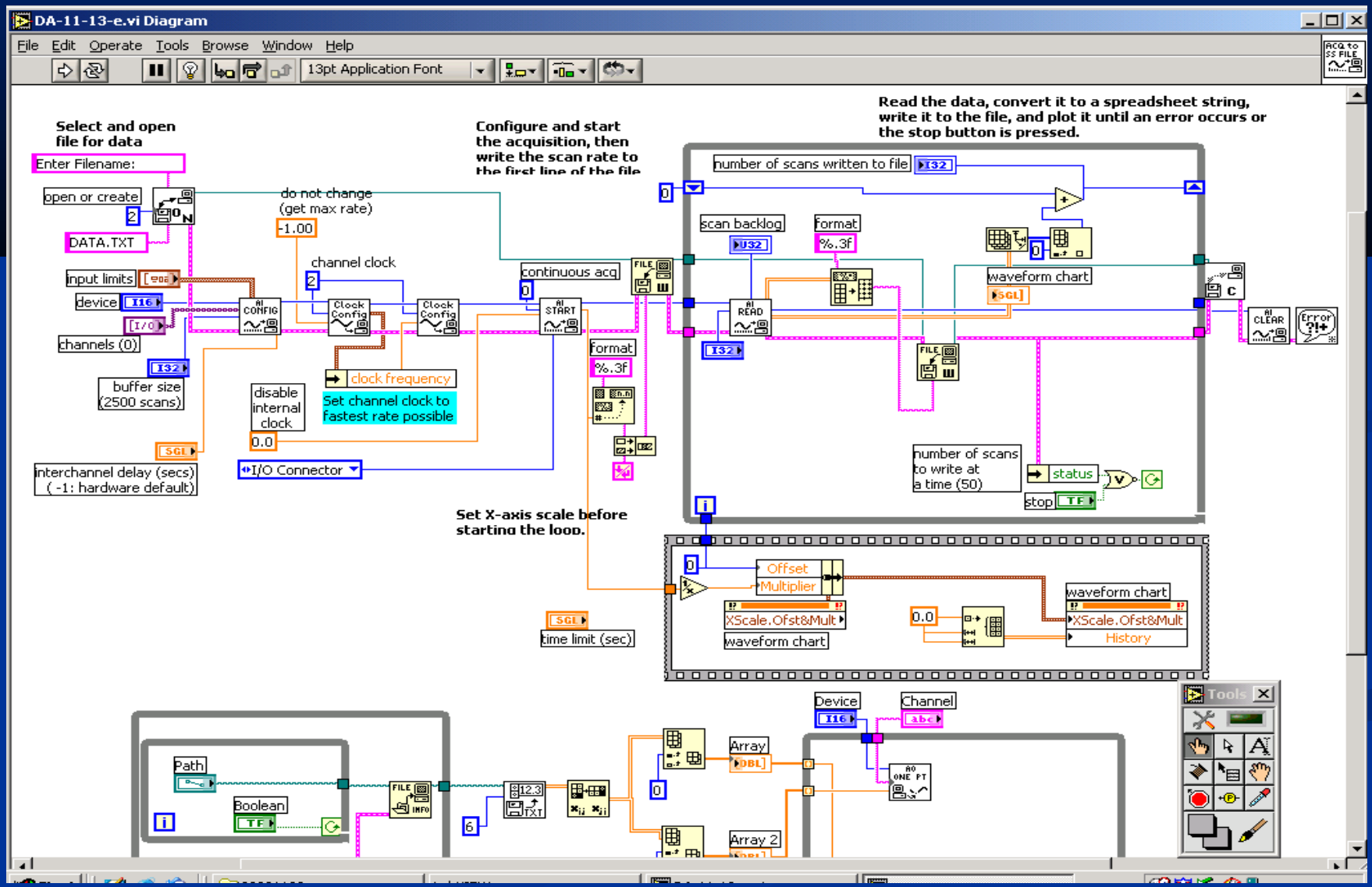
Our Simulator: Current Implementation

Braking system

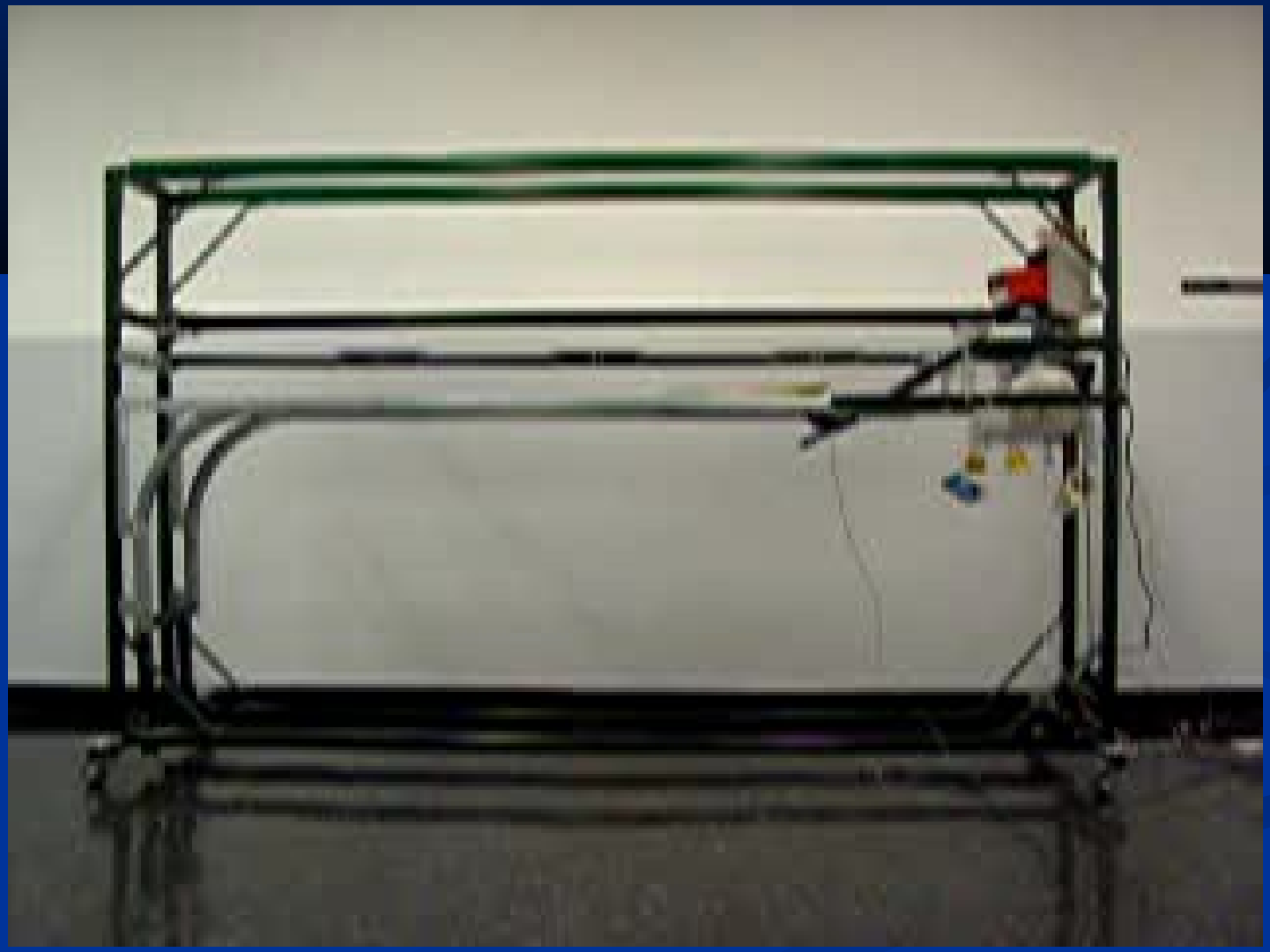
- Interfacing Mechanical and Electrical systems to achieve accurate load profiles.
- Development of an automated, real time Labview program to input, collect, and view load profile data on the arm.
- Input vs. Output
- Pips vs. Time



Labview Data Collection and Control Program



Garage Door Operator: Our simulator



Findings of current implementation

- Current simulation provides unidirectional force in each stage of operation: tension (opening), compression (closing).
- Our prototype can still simulate maximum load in each cycle.
- We believe this causes maximum wear to the parts that frequently fail.
- Inertia on current panel is very small; this results in a lot of vibration.
- Developed powerful Labview program for semi-automated process.

Recommendations

- Run an automated test of current system to failure.
- Add weight and a spring system to the panel
- Implementation of a motor coupled with braking system to simulate tension and compression in each stage of the cycle operation
- Implementation of a closed-loop feedback analysis.
- Further development of a computer based simulation to visualize garage door operator response to any change in the parameters
- Real-garage door or “field” data collection

Acknowledgements

- Chris Christophoros
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