Geoffrey Brown

Engineer.
Biomechanist.
Robotics.
Product Designer.

Bridging biomechanics research with precision mechanical design for human focused robotics.

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With a MS in Mechanical Engineering and deep human factors expertise, I am combining CAD-driven product development with biomechanics research to create hardware that optimally interfaces with human behavior. From patented rehabilitation devices to PNAS publications on human movement, I bridge engineering rigor with user-centered design.

Agility Trainer

Patented robotic rehabilitation device with VA-TEAM validation

Biomechanics Research

PNAS publications and 3D movement optimization studies

Northlake Labs

AI-powered biomechanics platform for custom robotics and complex workflows

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Rehabilitation robotics requires understanding both mechanical constraints and human factors. My research reveals how humans naturally move and orient in 3D space - insights that directly inform comfortable, population-spanning hardware design

Agility Trainer

Patented Robotic Rehabilitation Device

Two-Fold Research Challenge:

Clinical Tool Development:

Clinicians manually apply forces during gait training, but these interventions are inconsistent and unmeasurable. We needed a robotic system that could provide repeatable, quantifiable force application while preserving the clinician's ability to adapt interventions in real-time.

Novel Research Hypothesis:

Can a negative damping force field environment, using human-in-the-loop lateral velocity control, improve walking stability and balance outcomes during rehabilitation interventions?

Existing Limitations:

- ***Manual Interventions - Inconsistent, unmeasurable, clinician fatigue***
- ***Fixed Robotic Systems - No real-time adaptation to patient responses***
- ***Unknown force field potential - No platforms existed to test novel rehabilitation environments***

I designed a cable-driven robotic system that combines the measurability of robotics with the adaptability of human clinical judgment, while enabling entirely new research into force field rehabilitation environments.

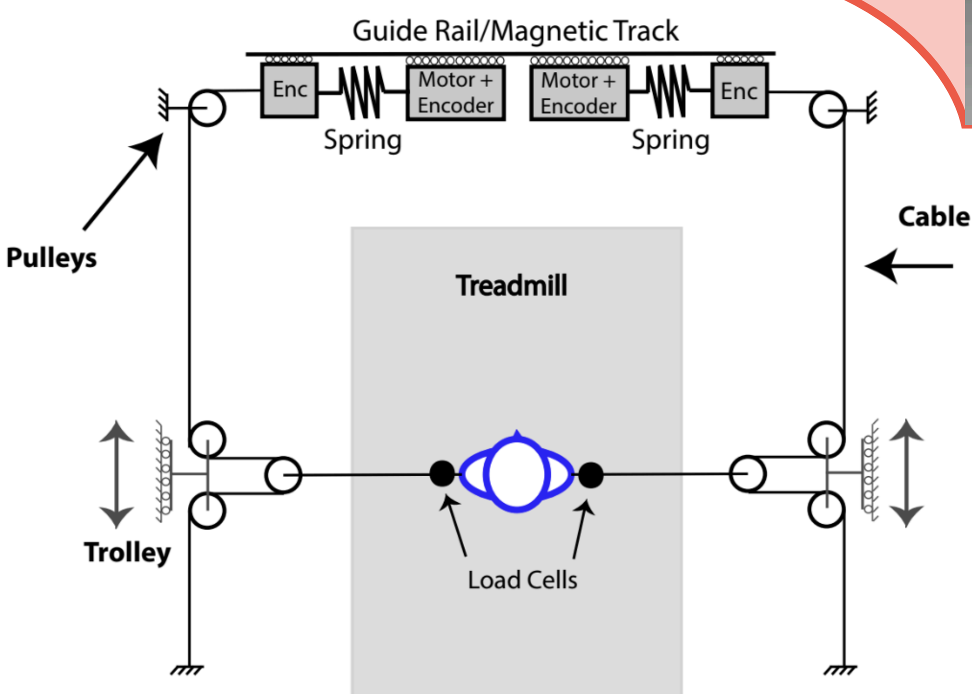
Agility Trainer

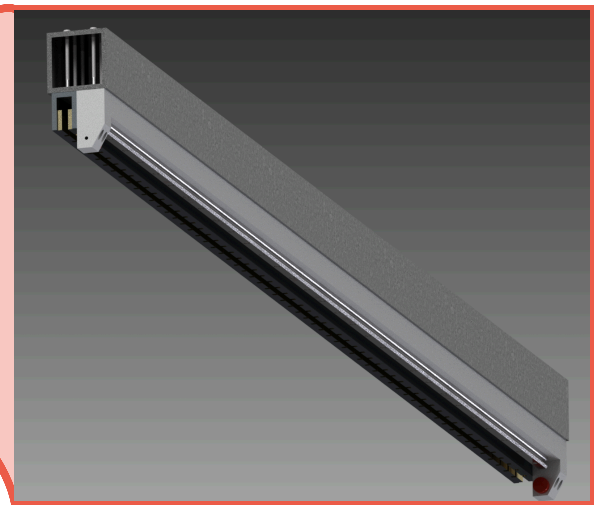
Design and Development

Systematic Mechanical and Control System Design

Top Down Schematic of Agility Trainer

Iterative design from 2014-2018 adding mechanical components and upgrading controls systematically





3d CAD render of linear motor rail

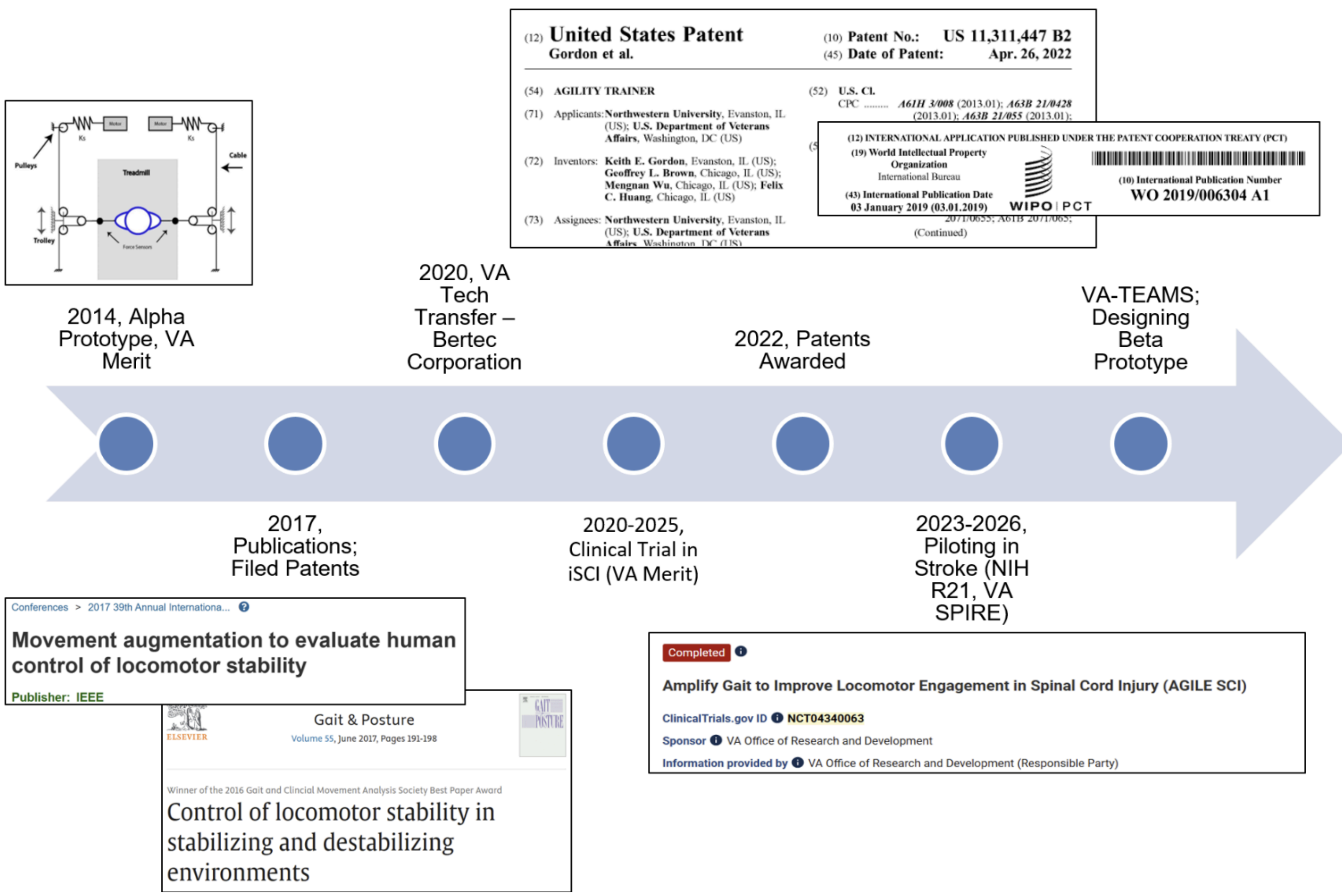
Challenge - getting aluminum surface almost 2m long machined to within 0.1mm flatness

- ***Dual encoders for** precise spring length control **and human velocity sensing***
- ***Mechanical advantage pulley system** maximizing force output **from motors***
- ***Human-in-the-loop** viscous force fields using real-time lateral velocity*
- ***Closed-loop force control via hip-mounted load cells for** safety and precision*
- ***Constant** iteration and validation **during human subject testing***
- ***Root cause analysis** for each failure led to systematic improvements in design*

Agility Trainer

Patent and Commercialization

Commercialization Timeline 2014-Present



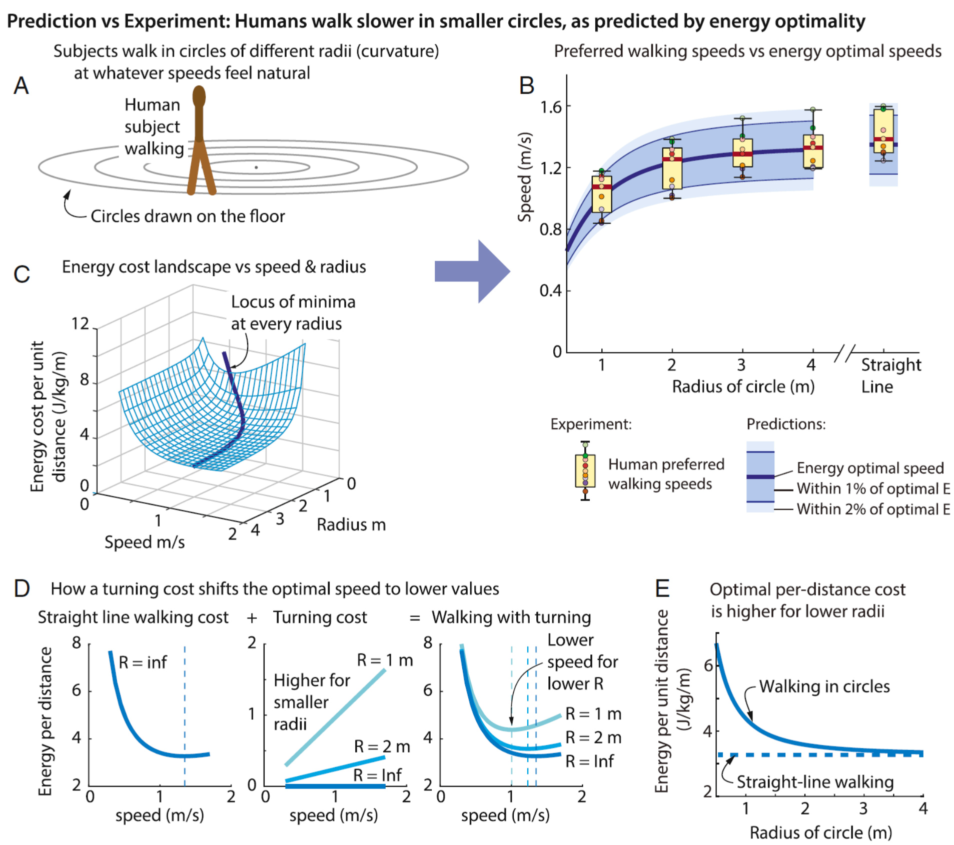
Successfully navigating the full product development lifecycle: patent creation, tech transfer partnerships, regulatory approval, and commercial validation. Experience moving breakthrough innovations from research lab to market deployment.

Biomechanics Research

Human Movement in 3D Space

PNAS Publication (2021) - First Author: "A unified energy-optimality-criterion predicts human navigation paths and speeds"

Research Approach: *Measured metabolic energy expenditure of 17 subjects walking in circles at different radii and speeds, then developed a mathematical model to predict optimal human navigation behavior in 3D environments.*



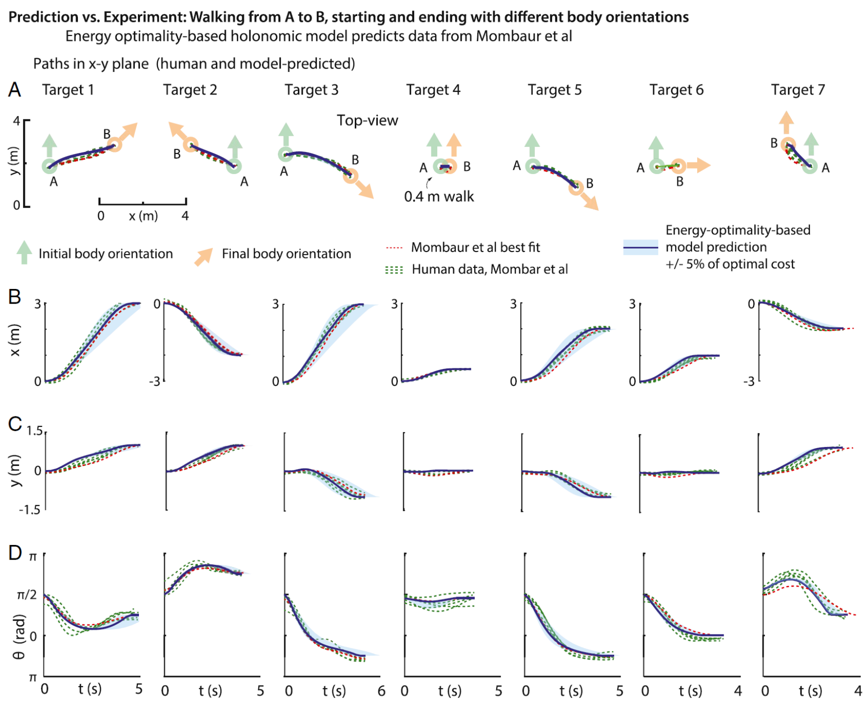
Key Discovery:

Humans naturally walk slower in smaller circles, exactly as predicted by energy optimization. This demonstrates that spatial navigation follows systematic principles - humans intuitively choose paths and speeds that minimize metabolic cost, not random preferences.

Published in PNAS (top 1% of scientific journals), this work provides the first unified theory explaining human movement patterns across diverse spatial navigation tasks.

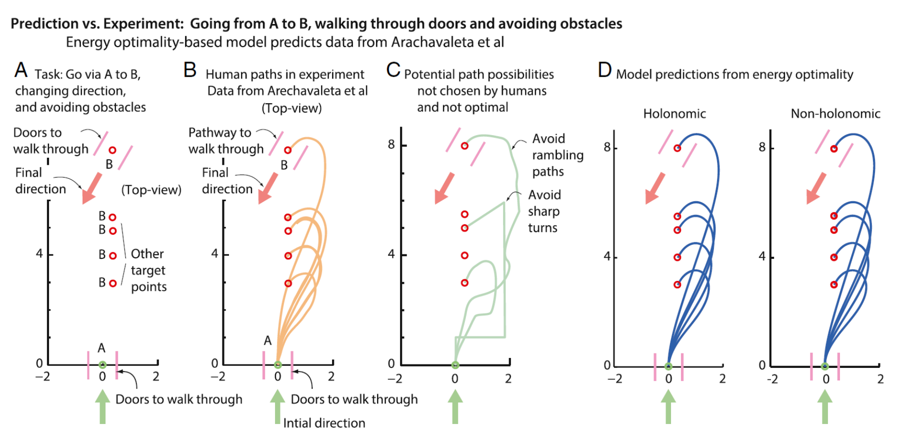
Biomechanics Research

Applications to Spatial Design



The energy-optimization model accurately predicts human walking paths and speeds across diverse navigation tasks - from simple point-to-point movement to complex orientation constraints. Humans consistently choose paths within 2% of energy-optimal trajectories.

The model successfully predicts how humans navigate around obstacles and through constrained spaces. These smooth, energy-efficient trajectories reveal fundamental principles for designing intuitive spatial interfaces that align with natural human movement patterns.



This research reveals fundamental principles for human naviagation: humans naturally optimize movement for energy efficiency. Understanding these patterns enables creation of human machine interactions that feel effortless and intuitive - working with human instincts rather than against them.

Northlake Labs

SaaS - Problem and Approach

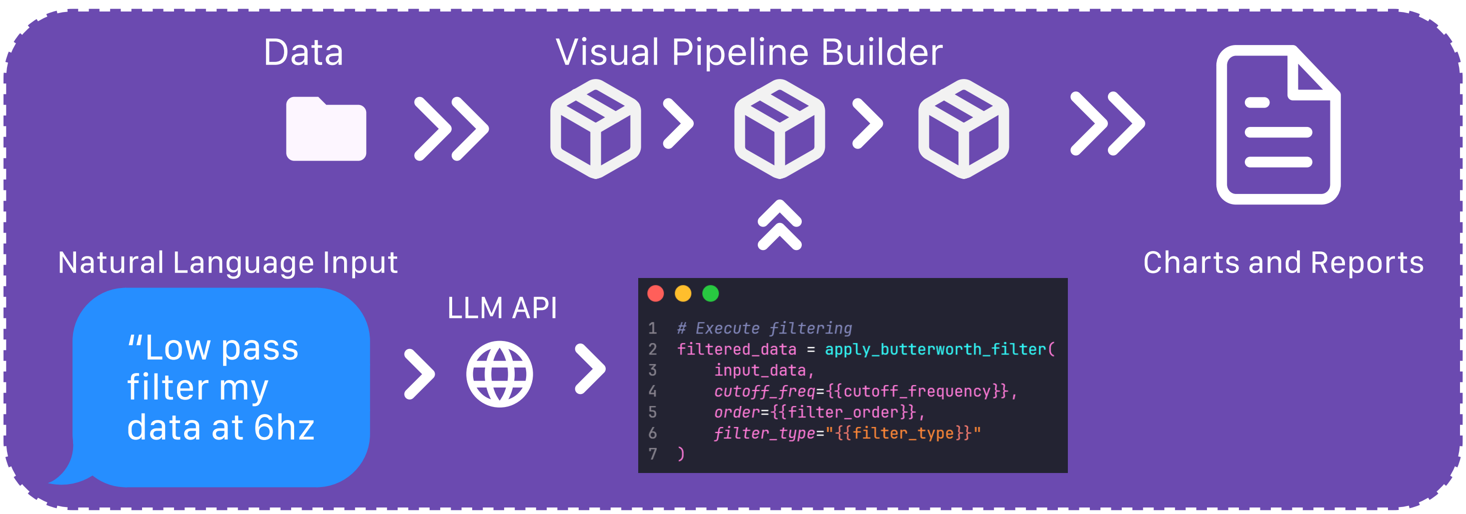
Problem: *Biomechanics groups generate massive datasets but often lack the programming skills to unlock meaningful insights. Current analysis tools force scientists to choose between limited pre-built functions/integrations or hiring expensive developers - creating a bottleneck that slows innovation.*

"I know exactly what patterns I want to find, but can't code the analysis"

"Our mocap system has analysis, but it doesn't integrate with our EMG system

"I'd like to use AI, but I'm concerned they are using our data"

Solution:



Research Approach: *20 years in biomechanics industry + targeted user interviews revealed that researchers need powerful customization without programming complexity*.

Privacy First

HIPAA compliant - data never leaves their machine

Transparent AI

Users understand what AI generates and why

Build in Front of Users

Continuous feedback from real researchers

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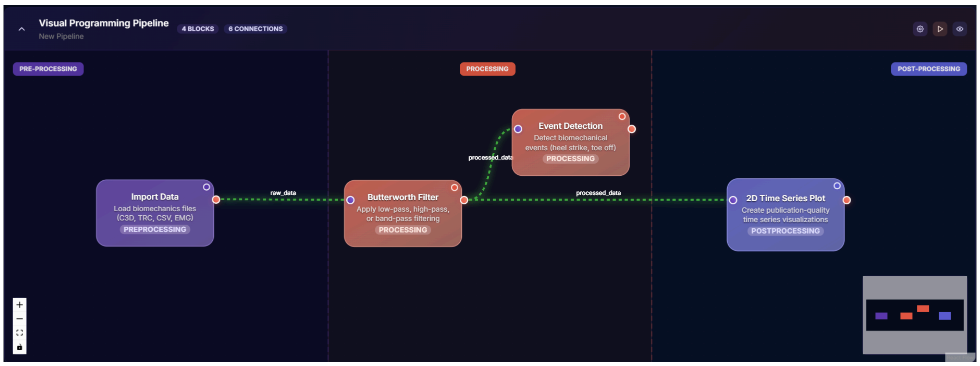
SaaS - Interface and Results

Currently in development with Q3 2025 launch target, validated through user interviews with biomechanics researchers.



Working SaaS interface: Users build analysis pipelines by connecting visual blocks, each powered by AI-generated Python functions tailored to their specific data and requirements.

Real output from the system: The visual workflow generates production-ready analysis and visualizations, enabling researchers to perform complex data processing without programming expertise.

This visual programming platform demonstrates core principles for implementing research into product design: enabling domain experts to manipulate complex workflows through intuitive interactions.

Contact

Information and Links

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