

Geoffrey Brown

Product Designer.
Engineer.
Biomechanist.

Bridging biomechanics research with
precision mechanical design.

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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

Vision Pro ergonomics 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*
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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*.

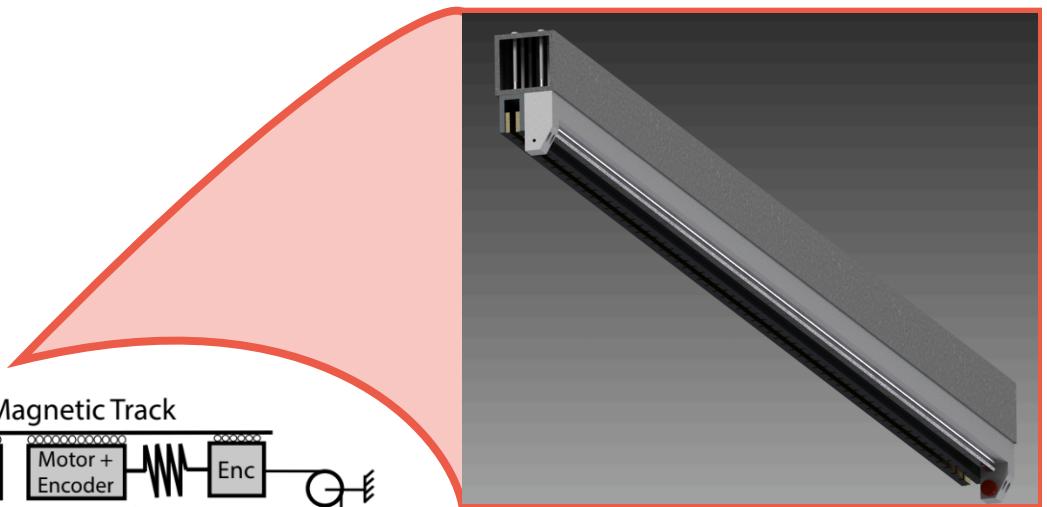
Agility Trainer

Design and Development

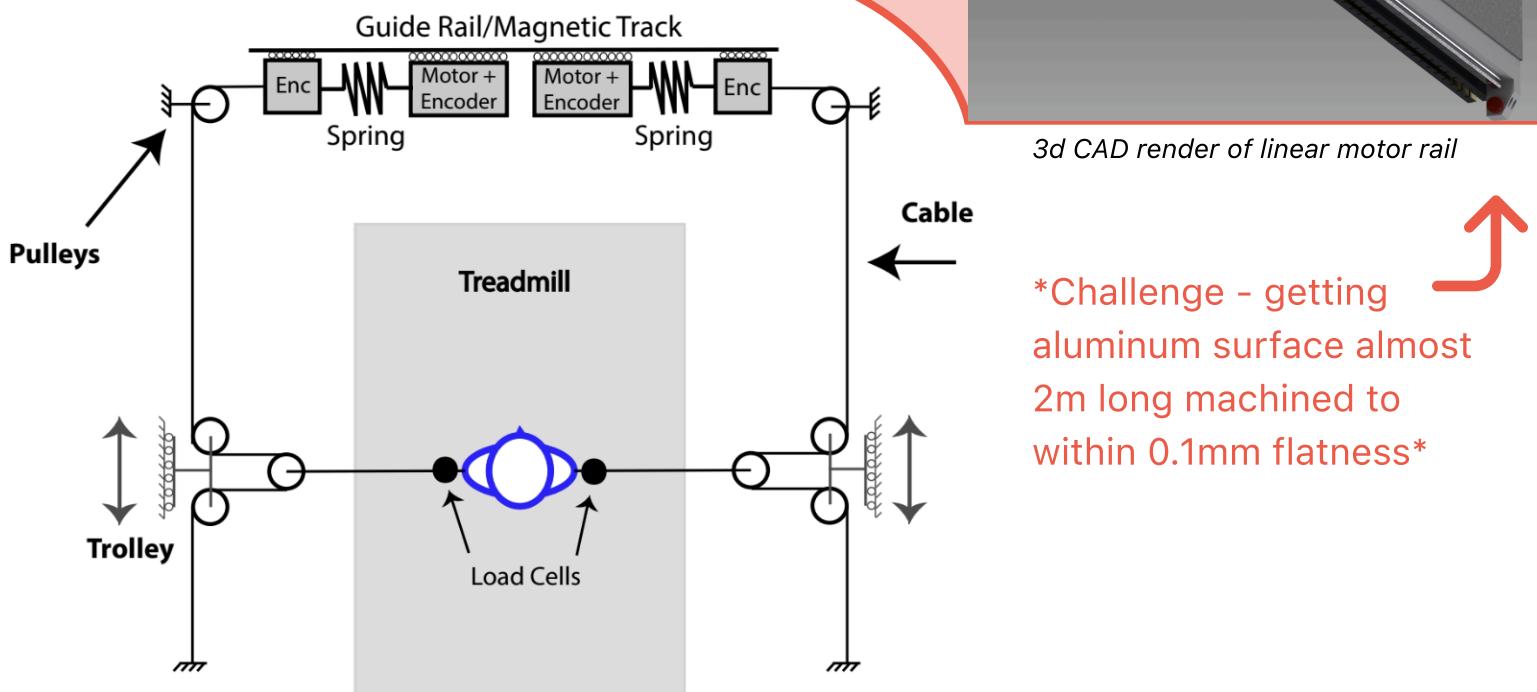
Systematic Mechanical and Control System Design

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

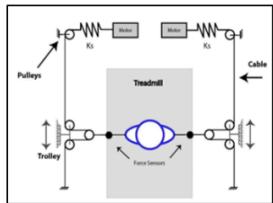


- Dual encoders for precise spring length control and human velocity sensing
- Mechanical advantage pulley system maximizing force output from motors
- Human-in-the-loop viscous force fields using real-time lateral velocity
- Closed-loop force control via hip-mounted load cells for safety and precision
- 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

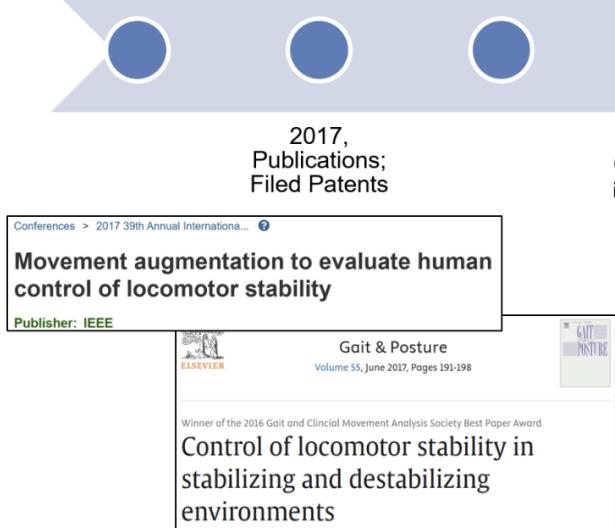
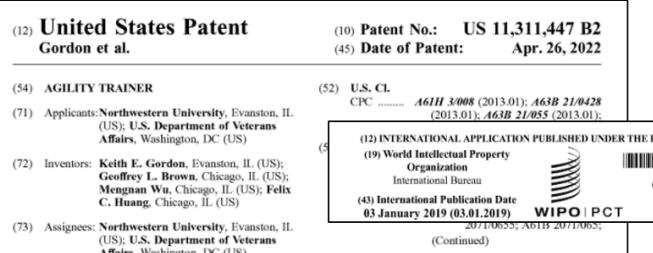


2014, Alpha Prototype, VA Merit

2020, VA Tech Transfer – Bertec Corporation

2022, Patents Awarded

VA-TEAMS;
Designing
Beta
Prototype



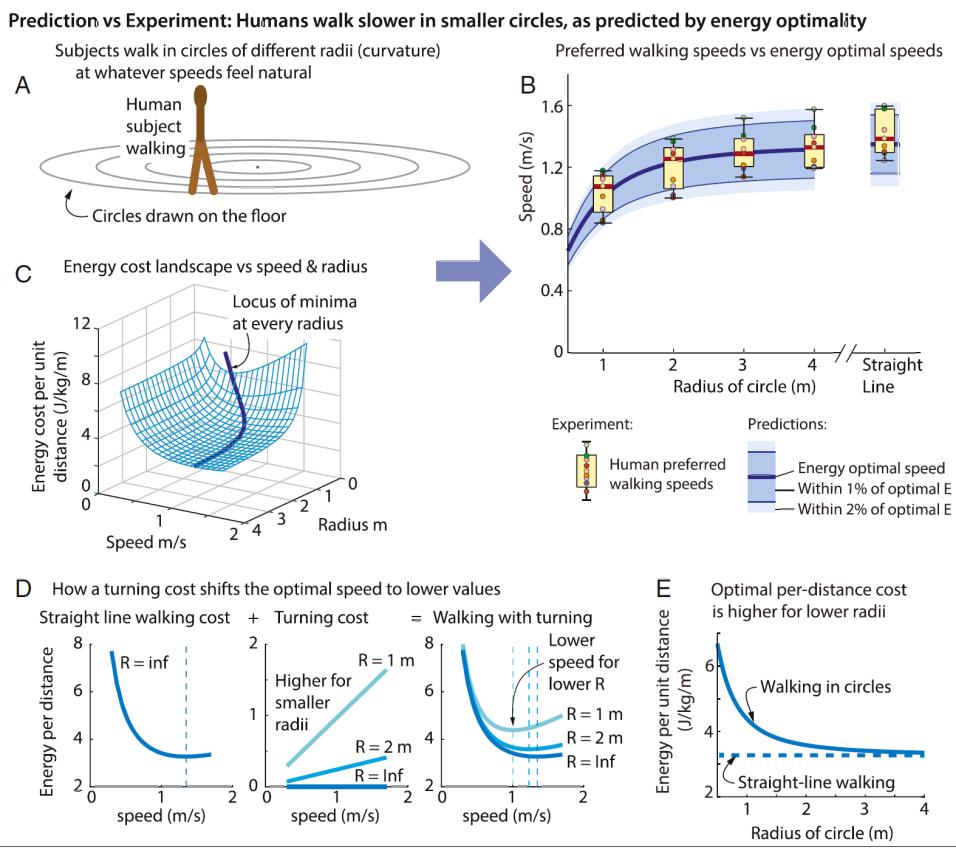
Successfully navigating the full *product development lifecycle*: *patent creation*, *tech transfer partnerships*, *regulatory approval*, and *commercial validation*. Experience moving breakthrough innovations from research lab to market deployment.

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.



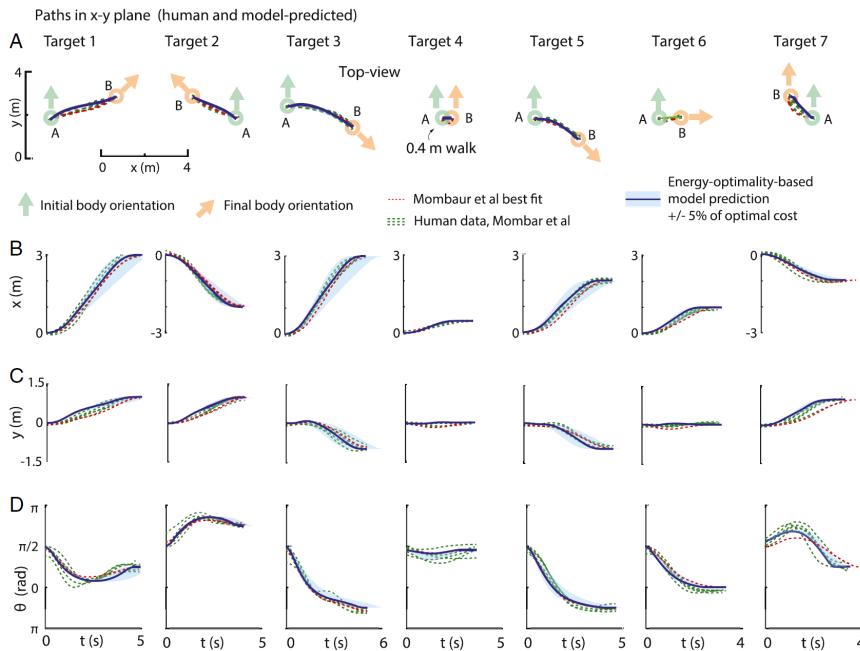
Key Discovery:
Humans naturally walk slower in smaller circles, exactly as predicted by energy optimization. This demonstrates that spatial navigation follows systematic principles - humans intuitively choose paths and speeds that minimize metabolic cost, not random preferences.

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

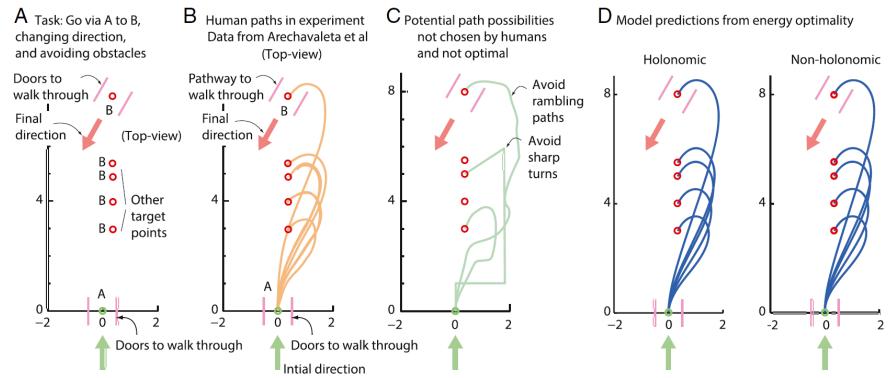
Prediction vs. Experiment: Walking from A to B, starting and ending with different body orientations
Energy optimality-based holonomic model predicts data from Mombaur et al



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.

Prediction vs. Experiment: Going from A to B, walking through doors and avoiding obstacles
Energy optimality-based model predicts data from Arachavaleta et al

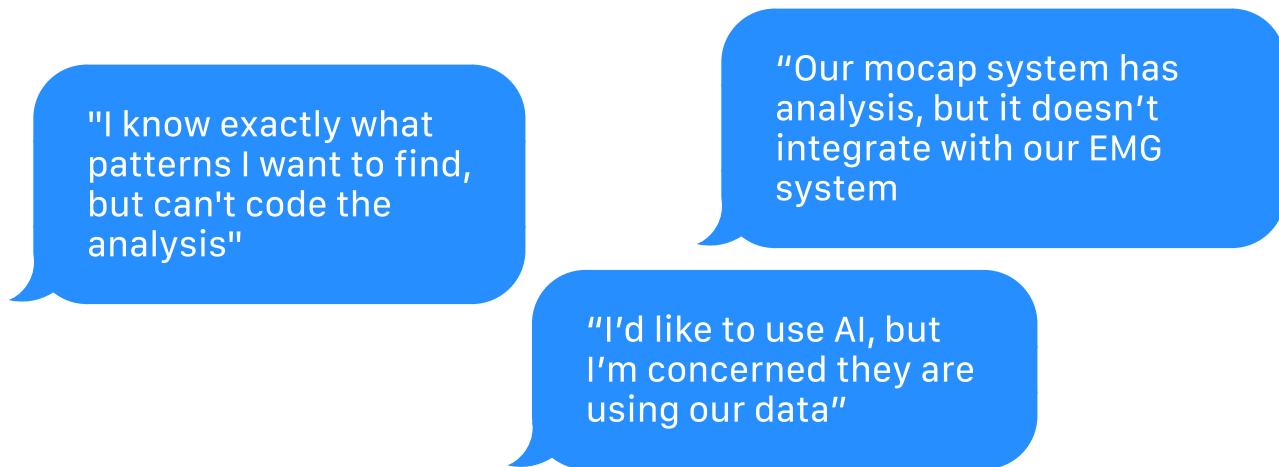


This research reveals fundamental principles for spatial interface design: humans naturally optimize movement for energy efficiency. Understanding these patterns enables creation of spatial experiences that feel effortless and intuitive - working with human instincts rather than against them.

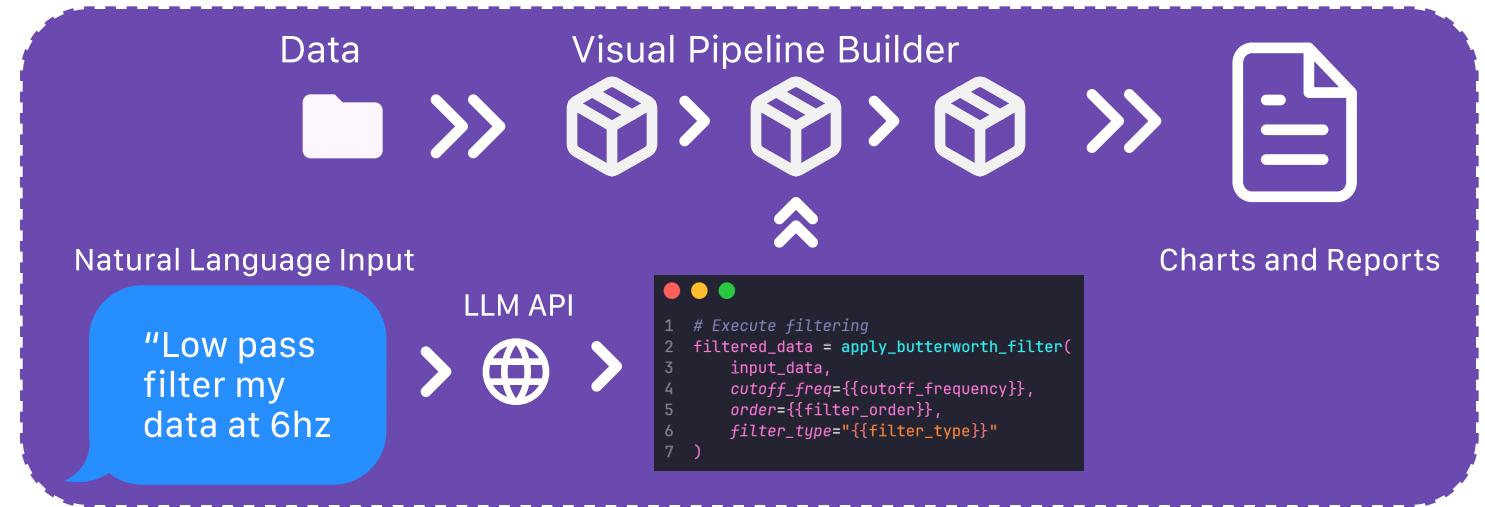
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SaaS - Problem and Approach

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.



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

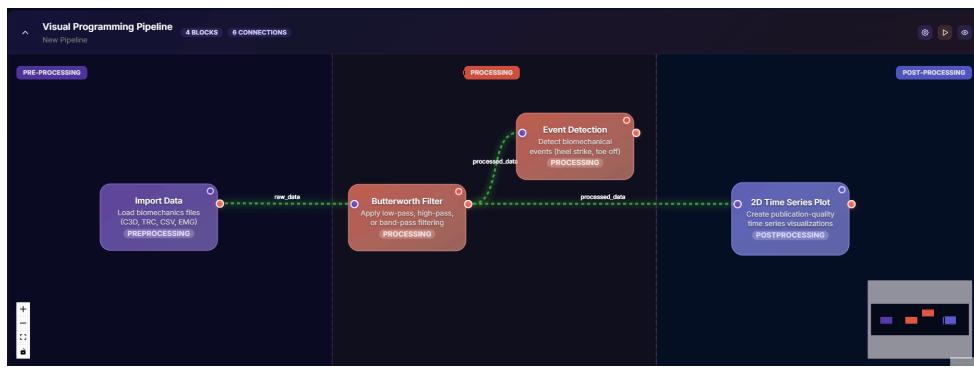
Build in Front of Users

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 spatial computing: enabling domain experts to manipulate complex workflows through **intuitive interactions**. This directly parallels **spatial interface design**, where users control sophisticated systems through natural gestures. Both require abstracting technical complexity into discoverable patterns that leverage **human spatial reasoning**.

Contact

Information and Links

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*Ready to apply research-driven innovation to
Vision Pro's design.*

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