Investigative Study of Animal-In-Motion-Optical-Sensor Measurements for Assessment of Musculoskeletal Impairments in Livestock

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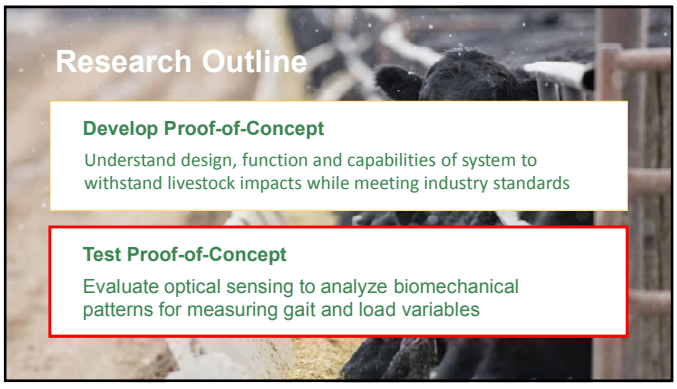
Background & Motivation

- Continuous, Real-Time Monitoring and Control
- New Applications in Analyzing and Managing
- Common Live-Animal Evaluation Tool

Research Outline



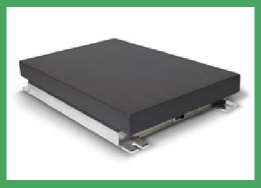
Develop Proof-of-Concept

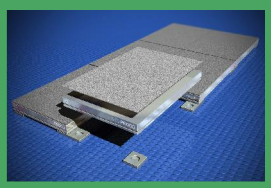
Understand design, function and capabilities of system to withstand livestock impacts while meeting industry standards

Test Proof-of-Concept

Evaluate optical sensing to analyze biomechanical patterns for measuring gait and load variables

Industry Systems

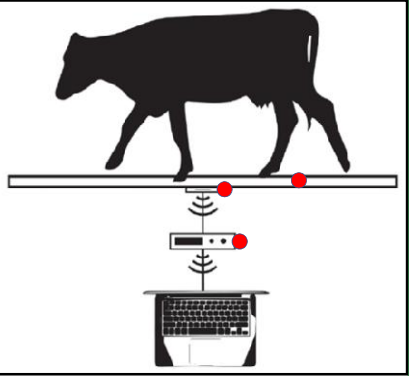




A. http://hertec.com/products/force-plates/
B. https://www.kistler.com/ch/en/products/products-by-applications/motion-gait-analysis-products/#large__force__plate_for__research_and__sports_9287_c
C. http://www.btsbioengineering.com/products/force-analysis/bts-p-6000/?gclid=CIPbyofpnNMCFQGPaQodkuQ17Q

System Overview

- Sensor-Integrated Platform
- Optical sensor encapsulated
- Compliant Anchoring
- High corrosion tolerance
- Synthetic top and base layers



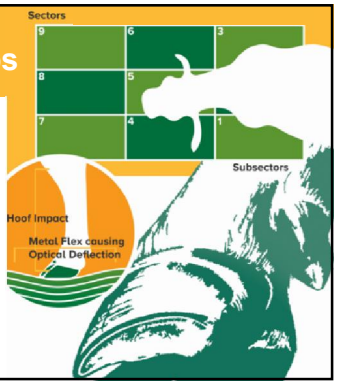
Experimental Design

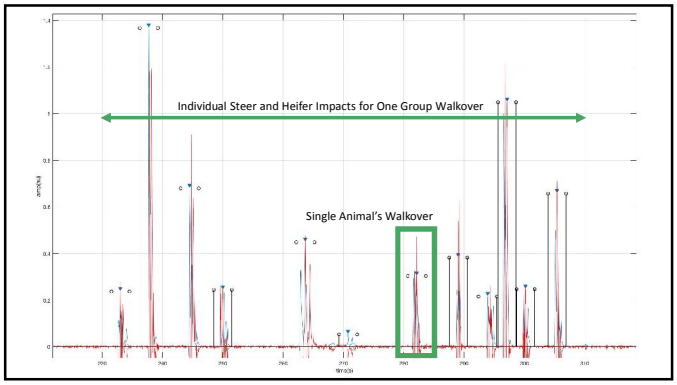
1 **50 Crossbred Steers and Heifers**
- 2 Test-Trial Days with ~6 runs per Animal
- n = 20, Angus; n = 10, Hereford; n = 10, Angus x Hereford

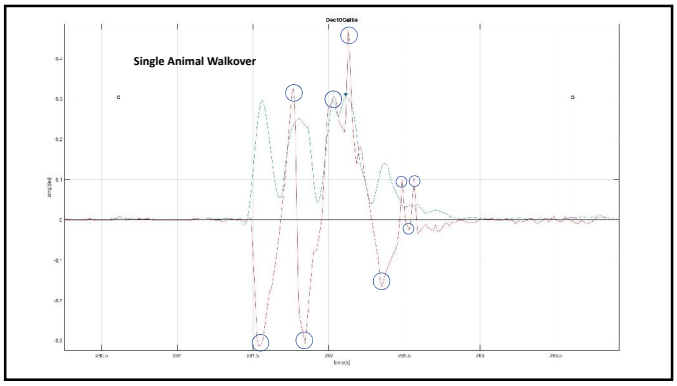
2 **3 Commercial Horses**
- 3 Test-Trial Days with ~10 runs per Animal per Day
- Pre, Post and Recovery (Saline / Botox Block)

Experimental Setups

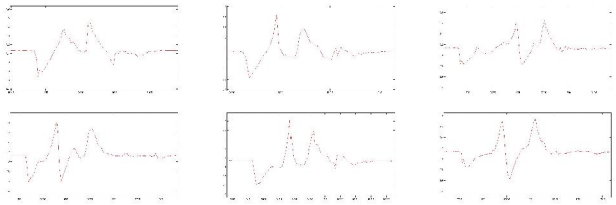
- Animals guided over platform
  - 3 sectors and 9 sub-sectors
  - Installed on level concrete pathway
- Animal's pass recorded electronically and with camera
- Videos evaluated concurrently
- Sensor output changes induced by mechanical plate flexure
- Data compared to individual animal's linear impacts





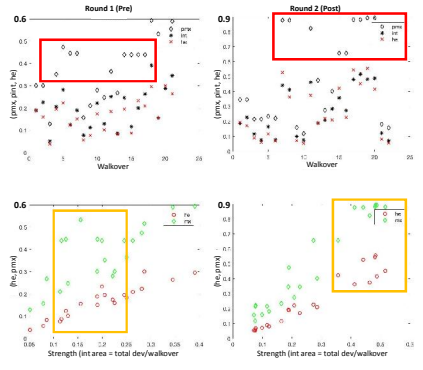


Repeatable Cattle Walkover Patterns

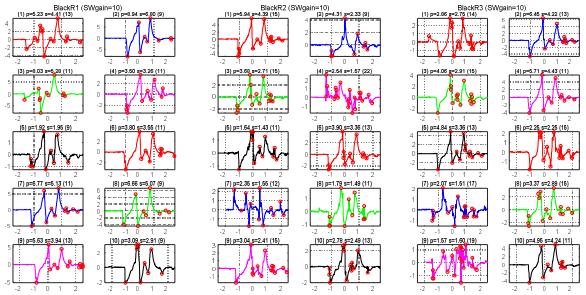


Horse #3 Analysis

- Induced Lameness resulted in Higher Number of Maxima in Horse #3
- Also resulted in Higher Number of Larger Maxima with heavier strength



Horse: Black (Pattern Clustering)



Summary & Conclusions

Current Results

- System detects hoof impacts
- System robust and accurate in livestock environment
- Individual patterns can be analyzed as normal or abnormal

Future Work

- Calibration tests – Finished this August
- Cluster pattern analysis
- Algorithm for real-time assessment