Ross Brancati, MS

PhD Candidate

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Summary

PhD student with 4 years of experience in human movement science research where I use technologies such as wearable sensors and optical motion capture systems to measure and monitor movement patterns. Specifically, my research leverages inertial measurement units to measure biomechanical time series data, along with data sciences approaches for characterizing signals associated with running related injuries. I am interested in applying my unique skillset, which bridges the gap between human performance research and data science, in a private sector organization.

Education

2020 – 2024 University of Massachusetts Amherst; Amherst, MA
PhD Student in Kinesiology
Concentration: Biomechanics
GPA: 3.93/4.0

2020 – 2022 University of Massachusetts Amherst; Amherst, MA
Computer Science and Statistics Departments
Graduate Certificate in Statistical and Computational Data Science
GPA: 3.80/4.0

2018 – 2019 University of Connecticut; Storrs, CT
M.S. in Biomedical Engineering
Concentration: Biomechanics
GPA: 3.9/4.0

2014 – 2018 University of Connecticut; Storrs, CT
B.S. in Biomedical Engineering
Concentration: Biomechanics
GPA: 3.5/4.0

Research Experience

Musculoskeletal & Orthopedic Biomechanics Laboratory, University of Massachusetts Amherst – Amherst, MA
Research Assistant, August 2020 – Present
PI: Dr. Katherine Boyer

- Identify biomechanical movement abnormalities in individuals with musculoskeletal injuries and of the aging population.
- Utilize data science approaches to analyze and interpret large sets of data produced by measuring human motion.
- Streamline time-taxing tasks by developing automated pipelines for data collection and processing procedures.
- Create high quality visualizations for presentations and publications for data analysis and interpretation purposes.
- Developing a running injury detection system using wearable technology and data science techniques.

University of Massachusetts Men's Ice Hockey Team, University of Massachusetts Amherst – Amherst, MA
Sports Science Intern, May 2022 – Present
Supervisor: Brandon Wickett

- Leverage Catapult's wearable technology to monitor player load and make informed decisions to reduce injury risk.
- Support development of interactive dashboards to help the sports performance team and coaches plan practices.
- Analyze and interpret large sets of longitudinal data for optimizing player work output, identifying asymmetries, and more.
- Simplify findings to interpretable formats for key stakeholders such as on ice, strength, and sports performance coaches.

Research Experience (continued)

Orthopedic Rehabilitation and Biomechanics Laboratory, University of Michigan - Ann Arbor, MI
Research Associate 1, May 2019 – August 2020
PI: Dr. Lindsey Lepley

- Examined biomechanical implications of ACL tears in animal models using deep learning-based motion tracking system.
- Wrote custom written scripts (Matlab) to automate data processing procedures such as ultrasound muscle fiber tracking.
- Developed data processing procedures for analyzing CT scans of animal model knee joints with knee osteoarthritis.
- Overhauled laboratory space including full synchronization of motion capture, force plate, and ultrasound systems.

Sports Optimization and Rehabilitation Laboratory, University of Connecticut - Storrs, CT
Graduate Researcher, December 2018 – May 2019
Co – PIs: Dr. Lindsey Lepley and Dr. Adam Lepley

- Investigated anatomical and pathological outcomes after traumatic joint injury, specifically ACL tears.
- Collected and analyzed biomechanical data including kinematics, kinetics, strength, muscle activation patterns, and more.
- Assisted other students with data processing procedures such as tracking of muscle fibers via ultrasound recording.

Teaching and Mentorship Experience

Kinesiology Department, University of Massachusetts Amherst – Amherst, MA
Teaching Assistant, February 2023 – Present
Primary Lecturer: Sarah Roelker

- Teaching assistant for an undergraduate kinesiology course titled *Kinesiology 430: Biomechanics.*
- Responsible for leading teaching lab sections, meeting with students, hosting office hours, and other teaching related tasks.
- The course is designed to help students develop an understanding of biomechanical concepts related to human movement.

Kinesiology Department, University of Massachusetts Amherst – Amherst, MA
Teaching Assistant, August 2022 – December 2022
Primary Lecturer: Gregory Grinnell

- Teaching assistant for an undergraduate kinesiology course titled *Kinesiology 110: Human Performance and Nutrition.*
- Responsible for leading discussion activities, meeting with students, grading assignments, and other related items.
- This class gives students necessary skills to critically evaluate information and research related to human performance.

Kinesiology Department, University of Massachusetts Amherst – Amherst, MA
Teaching Assistant, August 2020 – May 2021
Primary Lecturer: Thomas G. St. Laurent

- Teaching assistant for an undergraduate kinesiology course titled *Kinesiology 100: Introduction to Kinesiology.*
- Responsible for planning lessons, executing course material, and providing support for discussion section of the course.
- Topics included general kinesiology, health, nutrition, physical activity, biomechanics, and fitness testing.

Undergraduate Research Opportunity Program, University of Michigan - Ann Arbor, MI
Student Mentor, August 2019 – August 2020
Supervisor: Dr. Lindsey Lepley

- Recruit students in the Undergraduate Research Opportunities Program to participate in lab's research.
- Trained students on project specific protocols including collecting, compiling, and analyzing 3D CT scan image data.
- Simultaneously managed a total of 5 students by delegating tasks, responsibilities, and deadlines for projects.

MCB Department, University of Connecticut - Storrs, CT
Teaching Assistant, August 2018 – July 2019

- Lab teaching assistant for an undergraduate biology course titled *Biology 1107: Principles of Biology 1.*
- Responsible for teaching lab exercises, mentoring students, assisting students, grading, and hosting office hours.
- Learned and developed valuable skills such as lecturing, grading, and providing extra support for students.

Publications

1. **Brancati RJ**, Hamill J, Boyer KA. A Data Mining Approach for Determining Gait Abnormalities in Runners with Patellofemoral Pain Syndrome. *In Review.*

2. White MS, **Brancati RJ**, Lepley LK. Relationship between altered knee kinematics and subchondral bone remodeling in a clinically translational model of ACL injury. J Orthop Res. 2022 Jan;40(1):74-86. doi: 10.1002/jor.24943. Epub 2020 Dec 23. PMID: 33295680; PMCID: PMC8187469.

Publications (continued)

3. Davi SM, **Brancati RJ**, DiStefano LJ, Lepley AS, Lepley LK. Suppressed quadriceps fascicle behavior is present in the surgical limbs of those with a history of ACL reconstruction. J Biomech. 2021 Dec 2;129:110808. doi: 10.1016/j.jbiomech.2021.110808. Epub 2021 Oct 11. PMID: 34666248.

Conference Abstracts and Presentations

1. **Brancati RJ,** Kent JA, Hayes KL, Alvarado F, Boyer KA. Assessment of Aging Related Changes in Postural Control Using Time to Contact. UMass Amherst IALS Core Facilities Showcase. *Poster Presentation*. Amherst, MA. November 29, 2022.

2. **Brancati RJ**. A Data Mining Approach for Determining Gait Abnormalities in Runners with Patellofemoral Pain Syndrome. UMass Amherst Kinesiology Graduate Seminar Series. *Oral Presentation*. Amherst, MA. November 28, 2022.

3. **Brancati RJ,** Boyer KA. Data Mining Approach for Determining Gait Abnormalities in Runners with Patellofemoral Pain Syndrome. North American Congress on Biomechanics. *Running Symposium Presentation*. Ottawa, Canada. August 21-25, 2022.

4. **Brancati RJ,** Kent JA, Hayes KL, Alvarado F, Boyer KA. Assessment of Aging Related Changes in Postural Control Using Time to Contact. North American Congress on Biomechanics. *Oral Presentation*. Ottawa, Canada. August 21-25, 2022.

5. **Brancati RJ,** Boyer KA. Biomechanical Characteristics of Runners Recently Recovered from Patellofemoral Pain Syndrome. 9th World Congress of Biomechanics. *Oral Presentation*. Taipei, Taiwan. July 10-14, 2022.

6. **Brancati RJ**, Boyer, KA. Determining gait abnormalities in runners with patellofemoral pain syndrome using a data mining approach. UMass Amherst School of Public Health & Health Sciences Research Day 2022. *Poster Presentation.* Amherst, Massachusetts. April 6, 2021.

7. **Brancati RJ**, Kent JA, Boyer KA. Time to Contact Captures Declines in Postural Control Following Fatiguing Activity. 43rd Annual Meeting of the American Society of Biomechanics. *Oral Presentation.* Virtual Meeting. August 11, 2021.

8. **Brancati RJ**, Boyer, KA. Time to Contact Captures Declines in Postural Control Following Fatiguing Activity. UMass Amherst School of Public Health & Health Sciences Research Day 2021. *Oral Presentation.* Virtual Meeting. April 16, 2021.

9. Davi SM, **Brancati RJ**, Lepley AS, DiStefano LJ, Lepley LK. Examining the Dynamic Complexity of the Quadriceps Following Anterior Cruciate Ligament Reconstruction. National Association of Athletic Trainers Convention. *Oral Presentation.* Orlando, Florida. June 29, 2021.

10. White MS, Davi SM, **Brancati RJ**, Lepley LK. Alterations in Gait and Knee Joint Alignment Substantiate New PTOA Rodent Model of ACL Injury. Orthopaedic Research Society Annual Meeting. *Oral Presentation*. Phoenix, Arizona. February 10, 2020.

11. Lepley LK, White MS, Davi SM, Lepley AS, **Brancati RJ**. Novel Pre-clinical Model of Post-traumatic Osteoarthritis Demonstrates Unicompartmental Declines in Trabecular Bone Volume. Orthopaedic Research Society Annual Meeting. *Poster Presentation.* Phoenix, Arizona. February 10, 2020.

12. Davi SM, **Brancati RJ**, Lepley LK. Characterizing Abnormalities in Dynamic Quadriceps' Function Following Anterior Cruciate Ligament Reconstruction. Orthopaedic Research Society Annual Meeting. *Poster Presentation.* Phoenix, Arizona. February 8, 2020.

Private Sector Experience

Karl Storz Endovision., Charlton, MA
Continuous Improvement Intern, May 2018 - August 2018

- Implemented lean manufacturing techniques such as Kanban and Six Sigma to improve device production.
- Improved machine shop product flow by creating an efficient work environment and improving work culture.

Medtronic, North Branford, CT
Research and Design Intern, May 2017 - August 2017

- Performed feasibility and reliability testing on prototypes utilizing high tech machinery to optimize design.
- Analyzed data using Minitab to formulate statistical analysis of data sets and decide on design factors.

Academic Projects

Leveraging Wearable Technology for Monitoring Running Injuries Outside of a Laboratory Environment
Dissertation Project – Musculoskeletal & Orthopedic Biomechanics Lab, September 2021 – Present

- Running is one of the most accessible and popular forms of exercise, but almost half of all runners are injured each year. Patellofemoral pain accounts for a large proportion of those injuries and is known to cause alterations to neuromuscular control and biomechanics. Typically, biomechanical adaptations are measured in a lab environment, but clinicians do not have access to labs. Thus, the goal of this project is to develop a clinically translatable system that can measure adaptations displayed by individuals with patellofemoral pain using inertial measurement units and machine learning models.

A Data Mining Approach for Determining Gait Abnormalities in Runners with Patellofemoral Pain Syndrome
Research Project – Musculoskeletal & Orthopedic Biomechanics Lab, May 2021 – Present

- Biomechanics studies yield massive datasets that measure angles and loadings on joints along with muscle activation patterns. Typically, researchers extract single variables and test for statistical differences between groups. In this approach, I sought to use data science approaches such as principal component analysis and machine learning to understand which features of running gait are different between runners with and without patellofemoral joint pain.

Analysis of Aging Related Changes in Postural Control Using Time to Contact
Research Project – Musculoskeletal & Orthopedic Biomechanics Lab, October 2020 – Present

- Force plates utilize force transducers to generate forces in three dimensions, which can then be transformed to calculate metrics of the center of pressure (COP) such as its position, velocity, and acceleration. Time to contact, a metric derived from these features of the COP, is related to the perceived time to make postural corrections to prevent falls. In this project, I investigate how time to contact differs between younger and older adults to assess postural control.

An Exploration of Inertial Measurement Data in NCAA Division 1 Ice Hockey Players
Regression Analysis Class Project, September 2022 – Present

- Inertial data collected from microelectromechanical inertial measurement units provide data for coaches and sports performance teams to improve athlete performance. In this project, we explored a large data set derived from Catapult Sports units and used regression analyses techniques to help the UMass Amherst Ice Hockey sports performance team assess player load, determine athletes at high risk of injury, and ultimately optimize player performance.

A Data Visualization of Ski Resorts and Statistics Across the United States
Data Visualization Class Project, January 2022 – May 2022

- The United States hosts many ski resorts with varying levels of terrain, skiable acreage, and difficulty. Many skiers and snowboarders plan trips to various mountains throughout the US, so we sought to develop an interactive map with all the ski resorts (and their statistics) across the country that helps people plan ski-related trips. This data visualization dashboard was a map developed using HTML, the D3 JavaScript library, and GitHub for collaboration purposes.

Movie Recommendation Engine with a Simulated Feedback Analysis
Statistical Computing Class Project, August 2021 – December 2021

- A project inspired by the famous Netflix Prize competition, we sought to understand the self-modifying effects of recommendation algorithms which effectively create their own data to use in subsequent predictions and effect those predictions in unknown ways. We employed several machine learning algorithms for the recommendation engine, then ran a user-rating simulation to understand how the user's movie selections deviated from the original recommendations.

Pawpularity Contest – Generating a Cuteness Score of Adoptable Pets using Machine Learning Approaches
Machine Learning Class Project, August 2021 – December 2021

- A picture is worth a thousand words, but a picture can also save many lives. Animals up for adoption in Malaysia are often posted to a website with a photograph of the animal. Data has shown that animals with more appealing photos are more likely to be adopted. In this project, I built a convolutional neural network using tensorFlow to predict how appealing a pet photograph is, which achieved a good learning rate and a low root mean square error.

Other Projects

Gait Speed Classification with Wearable Sensors and Deep Learning
Data Science Portfolio Project – January 2023

- Gait speed (i.e., the time it takes to ambulate over a certain distance) is an important predictor of aging, pathology, or injury. As people age or suffer from a musculoskeletal disorder, they tend to walk slower. Typically, gait speed is collected in a laboratory environment, however wearable sensors allow for longitudinal monitoring of movement outside of a lab environment. In this project, I used an open-source dataset of signals from inertial measurement units to classify gait speed of 22 participants with deep learning and a leave one subject out cross validation approach.

Abnormal Heartbeat Detection using Deep Learning
Data Science Portfolio Project – December 2022

- Running is one of the most accessible and popular forms of exercise, but almost half of all runners are injured each year. Patellofemoral pain accounts for a large proportion of those injuries and is known to cause alterations to neuromuscular control and biomechanics. Typically, biomechanical adaptations are measured in a lab environment, but clinicians do not have access to labs. Thus, the goal of this project is to develop a clinically translatable system that can measure adaptations displayed by individuals with patellofemoral pain using inertial measurement units and machine learning models.

Skills

Programming Languages:

- Python (advanced – 3+ years)
- Matlab (advanced – 5+ years)
- R (advanced – 3+ years)
- Labview (beginner – 1 year)

Data Science:

- Data Wrangling and Preprocessing
- Signal Processing
- Feature Extraction
- Statistical Analysis (ANOVA, Regression Modeling)
- Data Visualization (ggplot, matplotlib, seaborn)
- Data Analysis and Manipulation (numpy, pandas, SQL)
- Machine Learning (scikit-learn)
- Deep Learning (pytorch, tensorflow)
- ML Operations (MLflow)
- Microsoft Excel

Movement Science Research:

- Wearable Technology (IMUs, EMG, HR)
- Human Subjects Research
- Image Processing (Dragonfly ORS, 3D Slicer, CT, MRI)
- Motion Capture (Qualysis, Vicon, Visual 3D)
- Electromyography (Delsys, BioPac, Neuraxon)
- Force Plates (AMTI)
- Ultrasound Imaging
- Institutional Review Board (IRB)

Engineering Software:

- SolidWorks CAD (intermediate – 2 years)
- Ansys Finite Element Analysis (beginner – 1 year)

Commercial Project Management:

- Agile
- Kanban
- Six Sigma

Grant Applications

1. National Biomechanics Day Loadsol Grant (2021) – Not Funded
2. National Biomechanics Day Loadsol Grant (2022) – Not Funded
3. DeLuca Foundation Training Initiative (2022) – Not Funded

Awards and Honors

2021	UMass Amherst School of Public Health and Health Sciences Research Day Award Winner - $1500
2020 – 2021	UMass Amherst Kinesiology Department Graduate Student Annual Travel Award - $150
2018 – 2019	Outstanding Teaching Assistant Recognition – MCB Department, University of Connecticut
2017 – 2019	American Collegiate Hockey Association Academic All-American
2017 – 2018	University of Connecticut School of Engineering Dean's List

Affiliations and Leadership

2020 – present	American Society of Biomechanics UMass Amherst Student Chapter – Vice President
2020 – present	American Society of Biomechanics Member
2020 – present	National Center for Neuromodulation for Rehabilitation Member
2019 – 2020	University of Michigan Undergraduate Student Research Program Mentor

Service

2021	National Biomechanics Day 2021 Virtual Outreach Event
2022	National Biomechanics Day 2022 Outreach Event

References

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