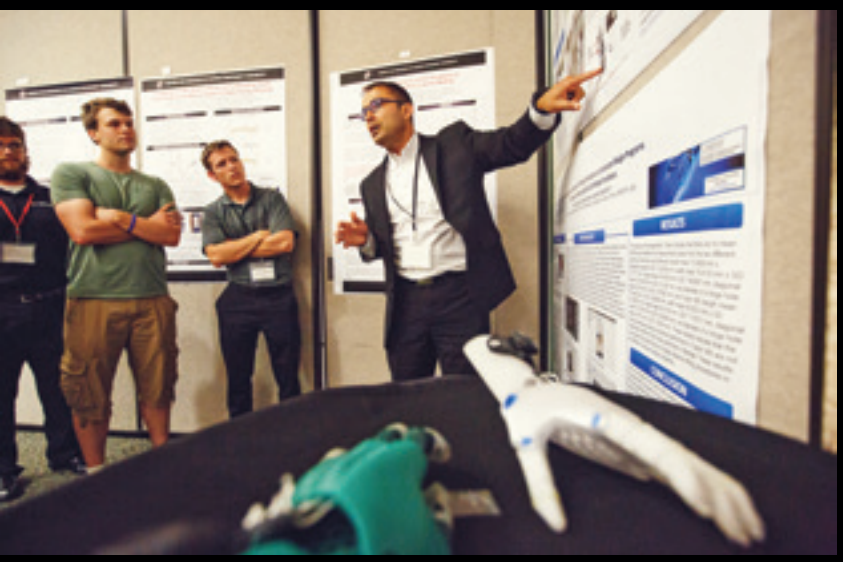
CENTER FOR RESEARCH IN
HUMAN MOVEMENT VARIABILITY

THE FOURTH ANNUAL

CONFERENCE IN HUMAN MOVEMENT VARIABILITY

UNIVERSITY OF NEBRASKA AT OMAHA | MAY 16 2019



University of Nebraska Omaha

PROGRAM AT A GLANCE

7:30 A.M. **ATTENDEE CHECK-IN OPENS**	
8:00 A.M. **WELCOME**	**Nick Stergiou, Ph.D.** Department of Biomechanics, University of Nebraska at Omaha
8:10 A.M. **INVITED SPEAKER**	**Jill McNitt-Gray, Ph.D.** Departments of Biological Sciences and Biomedical Engineering, University of Southern California
9:00 A.M. **BARRY T. BATES KEYNOTE SPEAKER**	**Didier Delignières, Ph.D.** Faculty of Sport Sciences, University of Montpellier
10:00 A.M. **POSTER SESSION A/ NETWORKING/VENDORS**	**Even poster numbers will present**
11:10 A.M. **PODIUM SESSION 1**	**Katherine Allen** **Blake Beier** **Farahnaz Fallah Tafti** **Christopher Hovorka, Ph.D.** **Annette Pantall, Ph.D.** **Ian Sloan**
12:25 P.M. **LUNCH/NETWORKING**	**Boxed lunches will be served**
1:05 P.M. **BARRY T. BATES HONORARY SPEAKER**	**Beverly Ulrich, Ph.D.** School of Kinesiology, University of Michigan
1:55 P.M. **PODIUM SESSION 2**	**Kostas Gianikellis, Ph.D.** **Arash Mohammadzadeh Gonabadi, Ph.D.** **Todd Leutzinger** **Shane Meltz** **Andreas Skiadopoulos, Ph.D.** **Basma Yacoubi, Ph.D.**
3:10 P.M. **POSTER SESSION B/ NETWORKING/VENDORS**	**Odd poster numbers will present**
4:20 P.M. **WRAP-UP/AWARDS**	

CONTENTS

ABOUT THE CONFERENCE

What is the Human Movement Variability Conference?

The Human Movement Variability Conference brings together researchers from across the globe to share their research in movement variability, and exchange ideas while exploring potential collaborations.

Who attends the conference?

The conference averages around 100 attendees each year and is comprised of students, faculty, and staff. Past attendees have been from the following institutions; University of Nebraska at Omaha (UNO), University of Nebraska Medical Center (UNMC), University of Nebraska-Lincoln, Creighton University, Boys Town National Research Hospital, Fast Twitch Sport Performance, Nagoya University, University of California Merced, Cleveland State University, University of Northern Michigan, and William Penn University. Previous keynote speakers have travelled from Tel Aviv Sourasky Medical Center, University of Nevada–Las Vegas, University of Florida, Medical University of South Carolina, University of Georgia, Iowa State University, University of Colorado-Boulder, University of Montpellier, U.S. Department of Veterans Affairs, and Vrije University Amsterdam.

WELCOME FROM THE PLANNING COMMITTEE

It is our great pleasure to welcome everyone to the 4th Annual Human Movement Variability Conference!

The planning committee is grateful to so many people for their contributions in making this a truly great conference. Thank you to our speakers for traveling to Omaha to share their prestigious research. Thank you to our vendors for providing state of the art equipment and supporting our researchers. Thank you to the staff of the Scott Conference Center for providing a truly world-class facility and exceptional service.

We are excited about so many exciting things happening today. Connecting vendors with scientists, connecting students with world-class researchers, and most of all expanding our knowledge of biomechanics and human movement variability!

Enjoy the day!

Internal Planning Committee Members

- Dr. Amelia Lanier, Outreach Coordinator, UNO, Committee Chair
- Dr. Joseph, Ka-Chun Siu, Associate Professor, UNMC, Committee Member
- Dr. Nate Hunt, Assistant Professor, UNO, Committee Member
- Dr. Vivien Marmelat, Assistant Professor, UNO, Committee Member
- Ms. Laura Rotert, Administrative Coordinator, UNO, Committee Member

External Planning Committee Members

- Dr. Evangelous Christou, Professor, University of Florida
- Dr. Carl Luchies, Associate Professor, University of Kansas
- Dr. Thomas Stoffregen, Professor, University of Minnesota

MESSAGE FROM THE DIRECTOR

DEAR CONFERENCE ATTENDEES,

Welcome to the Fourth Annual Conference in Human Movement Variability! I would like to thank our keynote speakers for traveling to Omaha to share their expertise in human movement variability.

We are so excited to host everyone and share all of the innovative biomechanics research happening in Omaha! This year has been full of tremendous progress that will continue into the next year. Our 30,000 square foot expansion is scheduled to be completed in August of this year and will double our research space. We are bringing an additional three faculty members who specialize in cardiovascular biomechanics, expanding our research expertise to yet another niche of biomechanics. We now offer a master's degree in biomechanics, allowing students to expand their knowledge of biomechanics and gain hands-on research experience in our world renowned facilities.

Please enjoy the knowledge shared today and the speakers and presenters hard work. Be sure to visit our website at cobre.unomaha.edu to stay up-to-date on our progress and upcoming events.

Warm Regards,
Nick Stergiou, Ph.D.

Dr. Nick Stergiou

Assistant Dean, Division of Biomechanics and Research Development, College of Education, University of Nebraska at Omaha

Distinguished Community Research Chair and Professor, Department of Biomechanics, College of Education, University of Nebraska at Omaha

Director, Biomechanics Research Building and Center for Research in Human Movement Variability, University of Nebraska at Omaha

Professor, Department of Agricultural and Occupational Health, College of Public Health, University of Nebraska Medical Center

CONFERENCE INFORMATION

Scott Conference Center
6450 Pine Street
Omaha, Nebraska 68106

Registration

Registration for the conference includes admission to all sessions, access to all coffee breaks, and lunch.

Name Badges

Your name badge is your admission ticket to the conference sessions, coffee breaks, and meals. Please wear it at all times. At the end of the conference we ask that you return your badge to the registration desk, or at one of the badge recycling stations.

Registration and Information Desk Hours

The registration and information desk, located in the foyer, will be open Thursday, May 16, 7:30 A.M. – 4:45 P.M.

Speaker Information

For podium sessions, the room will be equipped with

- 1 Surface tablet
- 1 laser projector
- 1 microphone
- 1 presentation tool

Poster Information

There are two poster sessions. Poster presenters must set-up their posters before 7:30 A.M. and remove them before 4.45 P.M.

Internet Service

Attendees have access to complimentary Wi-Fi in the meeting space area.

Network: **ScottConferenceCenter**
Password: **bestofomaha**

If you have any questions, please visit the registration desk.

Northwest/Southwest Room - Poster Presentations

Center Room - Keynote and Podium Presentations

Foyer - Exhibition/Refreshments and Lunch

DIDIER DELIGNIÈRES, PH.D.
MONTPELLIER UNIVERSITY
BARRY T. BATES KEYNOTE SPEAKER

Interpersonal coordination and complexity matching

Abstract

The complexity matching effect states that information transfer is optimized between systems sharing the same level of complexity, and represents a new framework for analyzing interpersonal coordination. Based on the hypothesis of a global, multi-scale interaction between cooperating systems, it has received considerable attention during the past decade. We proposed specific methods for distinguishing complexity matching from other kinds of synchronization processes, especially the discrete correction of asynchronies, or the continuous coupling between systems, considered as self-sustained oscillators. Our results showed that in most rhythmic or cyclical tasks (e.g., synchronized tapping or forearm oscillations), interpersonal coordination is mainly achieved by means of discrete asynchronies corrections. In contrast, we evidenced that side-by-side walking was dominated by complexity matching. Further research is needed for determining the factors that could favor the emergence of genuine complexity matching. Recent advances about complexity matching showed that when two systems of different levels of complexity interact, the most complex system tends to attract the less complex, yielding an increase of complexity in the second. This property suggests that deficient systems, characterized by a loss of complexity, could benefit from interactions with more complex systems, and especially a restoration of their initial level of complexity could be expected. We tested this hypothesis in an experiment where older participants were invited to walk in close synchrony with a young and healthy companion. We showed that the prolonged experience of complexity matching between participants and their companion allowed a perennial restoration of walking complexity in the former.

Bio

Dr. Delignières began his career in 1980 as a P.E. teacher in a secondary school. In 1990 he joined the Psychology Lab of the National Institute for Sport and Performance (Paris) and got his Ph.D. in 1993. He joined the Faculty of Sport Sciences of the University of Montpellier, as assistant professor in 1994, and became full professor in 1999. Since 2010, he is the Dean of the Faculty of Sport Sciences and the president of the (French) National Conference of Deans in Sport Sciences. His teaching activities are mainly devoted to the professional training of P.E. teachers. His research in the 1990's focused on motor learning, and especially the analysis of the evolution of complex skills with practice, from the point of view of the dynamical systems theory. From 2000 his research activities reoriented towards complexity and fractal fluctuations in rhythmic behavior. His most recent research is concerned with interpersonal coordination, conceived as the interaction between complex systems. This work combines theoretical, modeling, and experimental approaches. He especially investigates the occurrence of complexity matching effects between individuals in close coordination, and its potential use for rehabilitation purposes.

BEVERLY ULRICH, PH.D.
UNIVERSITY OF MICHIGAN
BARRY T. BATES HONORARY SPEAKER

Variability in the Development of Neuromotor Control

Abstract

We know that variability is ubiquitous in human movement. It has become clearer, with the advent of complexity theory and empirical data, that variability can be useful, and it can be problematic. Persistent challenges include distinguishing between helpful and detrimental levels of variability and determining how to optimize variability as adaptation. Young humans and those with physical disabilities tend to display much more variability than do healthy young adults. My lab group has focused on these populations. In the first part of my talk I will share results of studies in which we addressed variability from the perspective on nonlinear dynamics, using tools such as approximate entropy, Lyapunov exponent, and uncontrolled manifold analyses to study infants and children with Down syndrome and spina bifida. In the second part, I will share results from studies addressing variability using a variety of other analytical tools. My goal in sharing these data will be to illustrate that we can view the resolution of variability during the emergence of gait across levels of subsystems as a continuum, from those that stabilize more rapidly (e.g., joint coordination) to ones that emerge over longer time frames (e.g., cortical activation patterns). Common to this body of work is the recognition that variability holds a key to both understanding the emergence of gait control and this, in turn, offers insights to interventions designed to enhance control.

Bio

Dr. Beverly Ulrich is a developmental neuromotor control scientist. Her goals are to explain the processes that drive changes in patterns of motor behavior over time and build on that information to facilitate motor skill acquisition and the development of subsystems (e.g., neural, muscle, and bone) in persons with motor disabilities. She has used both linear and nonlinear tools to test hypotheses about gait development in infants and children with typical development, Down syndrome and myelomeningocele. In her talk she will highlight studies in which she used, for example, Lyapunov exponents (LyE) and goal-equivalent variability (UCMll) to examine variability. Dr. Ulrich has been PI on federal (NIH, NIDRR) and foundation grants, served as president of several professional societies and on several editorial boards, been an invited speaker around the world, and received numerous awards for her work. She served as Dean of the School of Kinesiology, Professor of Movement Science, as well as Research Professor in the Center for Human Growth and Development at the University of Michigan. Prior to that she was on faculty at Indiana University where she held an endowed professorship in Child Development.

JILL MCNITT-GRAY, PH.D.
UNIVERSITY OF SOUTHERN CALIFORNIA
INVITED SPEAKER

Common Control Mechanisms involved in Momentum Regulation

Abstract

Improving performance of well-practiced, goal-directed tasks, such as those performed during sport participation, involves generation and regulation of momentum during contact with the environment. Experimental and model simulation approaches have proven to be helpful in identifying common control mechanisms used by individuals to achieve the mechanical objectives of physically demanding tasks. Results from a series of studies on regulation of linear and angular momentum during the take-off phase of dives performed by elite divers will be used to provide insights regarding the control logic used by individuals to satisfy the mechanical objectives of tasks at the whole body and local levels. The implications of these findings will be discussed in regard to the mechanical demand imposed on the athlete, multijoint control preferences used by individuals across tasks, as well as considerations for purposeful practice and technique modifications specific to performance requirements. Once mechanisms used by individuals to regulate linear and angular impulse generation during interaction with contact surfaces this knowledge can be used to advance our working knowledge of multijoint control during momentum regulation and facilitate improvements in sports performance.

Bio

Dr. McNitt-Gray's research converges at the intersection of neuromuscular control and human musculoskeletal dynamics. Her team uses experimental and dynamic modeling approaches to test research hypotheses specific to control priorities during physically-demanding well-practiced tasks such as those regularly performed in sport. Findings from this body of work assist in the development of effective methods for risk reduction and performance enhancement of individuals with varied abilities including older adults and Olympic and Paralympic athletes. She actively collaborates with Rancho Los Amigos National Rehabilitation Center and the Veterans Administration and has served as a biomechanist for the International Olympic Committee, the US Olympic Committee, multiple National Governing Bodies of Sport, and the National Collegiate Athletic Association. Her research has been funded by the National Science Foundation and Department of Defense and governing bodies of sport. Dr. McNitt-Gray is a USC Mellon Mentor and is actively involved in translation of science into the practice, National Biomechanics Day, and role of sport in STEM education. Dr. McNitt-Gray completed her doctoral degree in biomechanics at the Pennsylvania State University. Prior to her doctoral studies, she completed her master degree in the area of biomechanics while serving as a graduate assistant coach at the University of North Carolina-Chapel Hill. She completed her undergraduate degree in mathematics and statistics at Miami University where she competed in two sports and earned a Certificate in Coaching. Dr. McNitt-Gray is a Fellow of the American Society of Biomechanics and the International Society of Biomechanics and a past president of the American Society of Biomechanics.

PODIUM PRESENTATIONS

Podium Session 1: 11:15 A.M. – 12:30 P.M.

PRESENTER	PRESENTATION TITLE
Katherine Allen	Training with lateral stepping improves clinical balance tests in older adults
Blake Beier	The Astro Xo™ exoskeleton alters ankle kinetics in healthy individuals
Farahnaz Fallah Tafti	Induced stress during dual task improved secondary task performance at the sacrifice of primary task performance
Christopher Hovorka	Maximizing orthosis stiffness and leverage isolates control of ankle motion
Annette Pantall	Effect of age and Parkinson's on multiscale entropy of electromyographic signals from leg muscles during over ground walking
Ian Sloan	Subthreshold vibration influences the posture and gait of transtibial amputees

Podium Session 2: 2:05 P.M. – 3:20 P.M.

PRESENTER	PRESENTATION TITLE
Kostas Gianikellis	Uncontrolled manifold analysis of gait variability in young adults with spastic diplegia
Arash Mohammadzadeh Gonabadi	Estimating variations of metabolic cost within the stride cycle during level and uphill walking
Todd Leutzinger	Single session walking adaptations to an ankle foot orthosis in patients with peripheral artery disease
Shane Meltz	Effect of dual-task walking on long-range correlations in people with Parkinson's disease
Andreas Skiadopoulos	The effect of a novel task intervention on gait variability in older adults
Basma Yacoubi	Temporal invariance in SCA6 reflects smaller cerebellar lobule V1 and greater disease severity

POSTER SESSION A

All posters will be displayed from 7:30 A.M. – 4:45 P.M. | Even-numbered posters will present from 10 A.M. – 11:15 A.M.

AUTHOR	POSTER #	PRESENTATION TITLE
Zainy M.H. Almurad	100	Restoring the complexity of locomotion in older people through arm-in-arm walking
Prokopios Antonellis	102	Effects of variations in timing and magnitude of forward forces at the waist on the metabolic cost of walking
Kyle Brozek	104	Visual contributions to balance control during gait
Samantha Chong	106	The effect of sensory input on the temporal structure of center of pressure in stroke survivors
Claudia Cortes Reyes	108	Assessment of 3D printed finger prostheses: a comparative case study
Alex Dzewaltowski	110	Collision work performed by patients with peripheral artery disease
Kostas Gianikellis	112	Variability in different minimally invasive proceedings
Tyler Hamer	114	The effects of joint angle variability across terrains on knee arthroplasty satisfaction
Alan Hoffman	116	Effect of motion capture sampling frequency on fractal fluctuations during treadmill walking
Hyeon Jung Kim	118	Cognitive impairment impacts single and dual task performance in older adults
Aaron D. Likens	120	Multifractal correlation reveals variation in complexity matching across metronome types
Ryan L. Meidinger	122	Neural mechanisms underlying sensorimotor synchronization with different forms of rhythms
Zachary Motz	124	Healthy young can flexibly switch postural sway with different stimuli
Annette Pantall	126	Changes over 36 months in nonlinear metrics of free-living gait in Parkinson's disease
Sheridan Parker	128	Reliability of IMU system compared to motion capture
James Pierce	130	Brain lateralization differences in pediatric prosthesis users
Douglas Rowen	132	Do older adults synchronize their strides to different visual stimuli?
David Salazar	134	Development of a 3D printed radial artery simulation model for ultrasound guided catheterization
Luis Silva	136	Synchronization between stride time intervals and external visual cueing
Michael Thompson	138	Applications of antimicrobial 3D printing materials in space
Connor Wicks	140	Daily activity in people with Parkinson's disease present less regular patterns
Henamari Ybay	142	Correlation between initial claudication time, absolute claudication time, and muscle oxygen recovery time

POSTER SESSION B

All posters will be displayed from 7:30 A.M. – 4:45 P.M. | Odd-numbered posters will present from 3:20 P.M. – 4:35 P.M.

AUTHOR	POSTER #	PRESENTATION TITLE
Cody Anderson	101	Intensity and pattern of daily physical activity of claudicating patients
Anthony Arellano	103	Muscle oxygenation in patients with peripheral artery disease during walking with and without an ankle foot orthosis
Russell Buffum	105	Evaluation of leg press instrumentation
Christopher Copeland	107	Bimanual coordination using prosthetic simulators
Kyle Doerr	109	Contributions of individual differences and context on dual-task performance in adults: maintaining independence and well-being in older adulthood
Greg Faber	111	A thermography-based analysis of foot temperature during locomotion
Angel E. Gonzalez	113	Foot thermal response to shear magnitude during curved-path walking
Erica A. Hedrick	115	Force, displacement, and work profiles of combined foot and ankle structures during typical walking
Andrew Kern	117	Do foot biomechanics affect plantar temperature in people with vascular disease?
Namwoong Kim	119	Influence of hip abductor fatigue on ACL loading during single-leg landing
Jenny Maun	121	The effects of a shock-absorbing pylon on mechanical work
Shane Meltz	123	Influence of music and metronome on gait and self-reported preferences in people with Parkinson's disease
Abderrahman Ouattas	125	Stability measures to compare fallers and non-fallers during locomotion
Nikos Papachatzis	127	Multiple gearing mechanisms of the human ankle-foot system during locomotion.
Jeffrey M. Patterson	129	Using sloped walking to investigate structure-function relationships in the foot
Corbin Rasmussen	131	The time of slip onset during stance influences the characteristics of the unconstrained perturbation
Takashi Sado	133	Passive exoskeleton assisted treadmill walking reduces duration and regularity of inter-limb coupling
Luis Silva	135	Multifractal analysis of visually cued stride intervals
Joel H. Sommerfeld	137	Altering aspects of gait through the use of pacing signals: a pilot study
Andrew Walski	139	Development of wearable aparatus for slip perturbations
Casey Wiens	141	Differences in upper extremity and torso control after wheelchair reconfiguration
Lauren Yoksh	143	Effect of treadmill walking with handrails on gait dynamics in people with Parkinson's disease

UNO BIOMECHANICS

The Center for Research in Human Movement Variability (MOVCENTR) is dedicated to bringing scientists and established clinical investigators together.

Human Movement Variability

The majority of the students are in biomechanics and/or motor development and control, but we also have students from mechanical engineering, neuroscience, biology, etc. It is evident that our COBRE absolutely transforms the research culture in our institution by augmenting the research "know-how" assets within the university.

Why?

- To look at a variety of motor-related disorders in the neuromuscular system.
- MOVCENTR scientists are researching optimal approaches for therapies on the restoration of variability and complexity of movement that could be applied across a range of diseases.

How?

- Funding through the National Institutes of Health and National Institute of General Medical Sciences.
- COBRE Award P20GM109090, is now in the fifth year of funding.
- Providing funding for research projects, pilot projects, faculty, student research experience, and staff.

Growth

- The MOVCENTR facilities are more than doubling in size. The Biomechanics Research Building is in progress to expand the facilities by 30,000 square feet. The expansion is scheduled to open in September 2019.
- MOVCENTR has received national recognition for our state-of-the-art facilities, by our faculty presenting research at national conferences, and performing collaborative research across the country.

UNO BIOMECHANICS (CONTINUED)

Education

- The Bachelor of Science in biomechanics degree and the minor in Biomechanics is available for undergraduate students.
- The Master of Science in biomechanics is the newest edition to our growth of education.

Impact

- The MOVCENTR conducted an economic impact evaluation through UNO's Department of Economics to determine the economic impact the MOVCENTR has had on the Omaha Metropolitan area. It was determined that each year the COBRE award provides over $1.5 million dollars back into the community.
- Faculty research project leads have received additional funding through the NIH, the American Heart Association, and the NSF, including an NIH R01, an NIH R15, and AHA fellowship, and two NSF EPSCoR FIRST Awards.
- Doctoral students funded by the MOVCENTR have received funding through the NIH, NSF, and AHA, including an NIH F31, NSF Fellowship, and AHA Doctoral Fellowship.

Recognition

The Stanford Research Institute (SRI) International provided a comprehensive report of the biomedical technology capabilities to the state of the Nebraska. In this report SRI stated that "The University of Nebraska at Omaha is home to world-class research in biomechanics." Furthermore, biomechanics was ranked as No. 9 (tied with Northwestern University and University of Pittsburgh) in the USA. This was the highest ranking achieved by any other biomedical technology field in the University of Nebraska System. We are certain that our Center's successes have allowed us to receive such a national ranking.

UNO MACHINING AND PROTOTYPING CORE

Machining and Prototyping Core Facility

The Machining and Prototyping Core Facility involves the use of three major facilities within the University of Nebraska at Omaha Biomechanics Research Building: The Machine Shop, Electronics Workshop, and the 3D Printing Laboratory. The most basic function of the Core is to provide services that use these spaces and their personnel and equipment. These services are for professionals in the University of Nebraska system, the local area, and also to people outside our state to progress their research or other projects. The Core can design, prototype, manufacture and repair, maintain, or install a wide range of devices and instrumentation.

Machine Shop

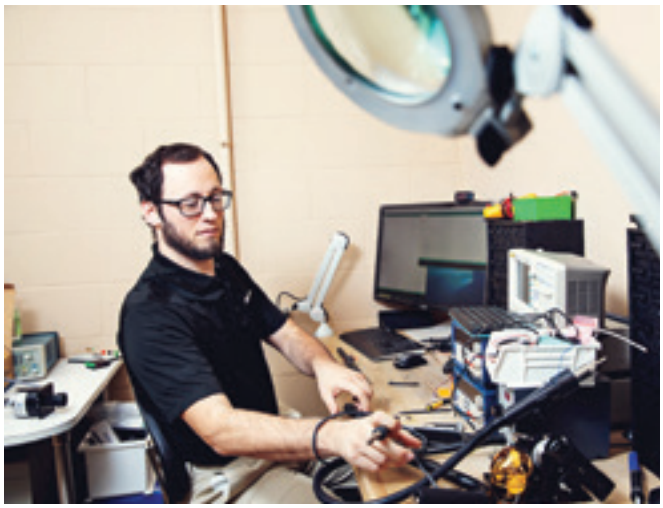
The 500 square foot Machine Shop is equipped with both traditional and advanced machinery that allows for the construction and fabrication in woods, metals, plastics, and unique composite materials. Equipment in this space includes a wide assortment of hand tools, a traditional knee mill, metal lathe, 3-Axis CNC milling machine, vertical band saw, table saw, compound miter saw, drill press, belt/disc sander, bench grinder, laser cutter, and a high-resolution 3D scanner. In addition to the tooling, several design workstations running the Autodesk Suite, Adobe Creative Cloud, and Solidworks are used by staff and student engineering technicians. The machine shop and adjacent washroom (8' x 15') were also designed for typical prosthetics casting with a plaster modification area with grated, recessed flooring, and an oversized fume hood for carbon fiber lamination.

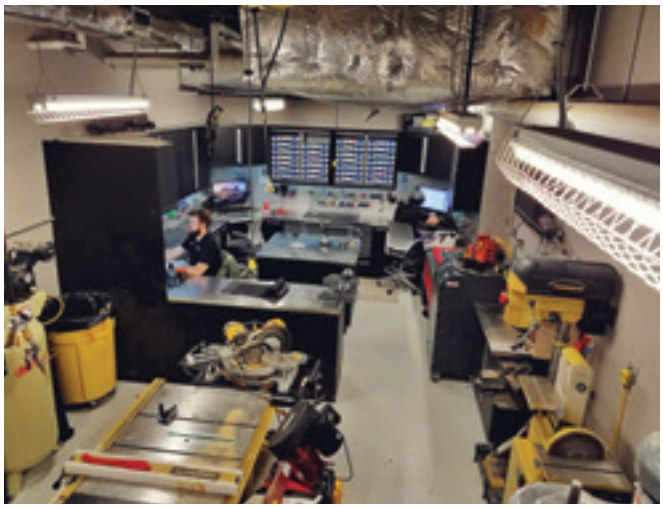
Electronics Workshop

The Electronics Prototyping Workshop boasts an inventory of prototyping supplies that allow for a drastic reduction in lead time for projects requiring complex electrical system components that include Arduino, Raspberry Pi, and embedded systems. This 200 square foot workshop contains an electrostatic dissipative workstation equipped with an oscilloscope, digital power supply, soldering station, reflow oven, dedicated programming workstation, and a CNC PCB milling machine.

3D Printing Laboratory

The 3D printing Laboratory is a 300 square foot room equipped with an industrial PolyJet 3D printer, two semi-industrial 3D printers, a stereolithography liquid resin printer, eight desktop 3D printers, four high resolution dual extrusion printers, a large format printing workbench, one selective laser sintering printer, and a new direct metal laser sintering machine that adds aluminum, titanium, and stainless steel alloys to our wide range of material options.





Personnel

Dr. Brian Knarr, Core Facility Director
Mr. Travis Vanderheyden, Research Development Engineer

THANK YOU TO OUR SPONSORS

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