

# **Curriculum Vitae**

## **Sandra Anstaett Metzler, D.Sc., P.E.**

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### **CONTACT INFORMATION**

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### **EDUCATION**

**Doctor of Science, Mechanical & Biomedical Engineering** **May 2000**  
Washington University in St. Louis, St. Louis, Missouri  
Dissertation: Analysis of Drill Dynamics, Including Bending Axial and Torsional Effects

**Master of Science, Mechanical Engineering** **December 1997**  
Washington University in St. Louis, St. Louis,  
Missouri  
Stability Prediction of Nonlinear Oscillations via Discrete Dynamic Models

**Bachelor of Science, Mechanical Engineering** **May 1983**  
Purdue University, West Lafayette, Indiana

### **TEACHING AND RESEARCH FOCUS**

My approach to both teaching and research is a natural outgrowth of my extensive industry experience. I teach courses with an emphasis on applying the breadth of engineering science topics learned throughout the curriculum to real-world problems, and the development of solutions that are intended for adoption in industry, research, and consumer applications. My research involves application of mechanical design principles and smart sensor technologies to a range of human centered design projects, including rehabilitation engineering, assistive technologies, and smart product design.

### **INDUSTRY EXPERIENCE**

**Independent Consultant** **2014 to present**  
Metzler Consulting  
Columbus, Ohio

- Perform design and manufacturing analysis and testing for a range of products, including medical devices and consumer products.
- Perform human factors engineering analyses including issues related to cognitive, perceptual, and reaction abilities.
- Technical areas of expertise include a wide range of engineering product design competencies, including: design for assembly and manufacturing, mechanical testing, CAD modeling, Finite Element Analysis, Computational Fluid Dynamics Analysis, mechatronic design, vibration analysis, product literature and warning design.

**1988-1995**  
Overland Park, Kansas, and St. Charles, Missouri

- Assisted small- and medium-sized businesses by developing custom software solutions to address

internal business needs.

- Developed and conducted courses in Statistical Process Control and Experimental Design.

### **Technical Consultant**

**2004 to 2013**

SEA, Ltd., Columbus, Ohio

- Conducted design and failure analysis of biomedical and mechanical devices and products.
- Performed accident and failure analysis on mechanical systems, including vehicle accident reconstruction and occupant kinematics.
- Performed human factors analyses for products and accidents.
- Performed research and analysis in the areas of product design and safety, biomechanics, and ergonomics.
- Testify in state and Federal courts as an expert witness over 100 times.
- Organizer and peer reviewer for the American Society of Mechanical Engineers, the Human Factors and Ergonomics Society, and the Society of Automotive Engineers.

### **Software Instructor and Developer**

**1993-1995**

Systems Service Enterprises, St. Louis, Missouri

- Developed custom software applications using Microsoft Visual C++ and Visual Basic.
- Developed curriculum and conducted hands-on software training courses.

### **Quality Engineer**

**1989-1991**

Marion Merrell Dow Kansas City, Missouri

- Implemented Statistical Process Control (SPC) techniques in the manufacturing of pharmaceutical products.
- Developed standard procedures for testing and validation of new products.
- Conducted training classes in SPC for manufacturing personnel.
- Performed and analyzed process capability studies for pharmaceutical manufacturing processes.

### **Manufacturing Engineer**

**1984-1987**

Puritan-Bennett Corporation Lenexa, Kansas

- Responsible for manufacturing systems staffing, production planning, methods improvement, and compliance with Good Manufacturing Practice (GMP) Requirements for medical equipment manufacturing department.
- Supervised successful pilot program for new Manufacturing Resource Planning (MRP II) production system.
- Organized and led a manufacturing improvement team in the Chemical Manufacturing area that utilized Design of Experiments (DOE) and Statistical Process Control (SPC) techniques to improve processing methods.
- Coordinated development, purchase, and installation of SPC system for injection molding department.

### **Industrial Engineer**

**1983-1984**

General Motors Corporation Fairfax, Kansas

- Performed ergonomics and methods analysis, tool and fixture design, time studies, line balancing,

- and labor report generation for an automotive assembly facility.
- Member of the manufacturing design team to develop a complete facility redesign proposal, which resulted in selection as the site of manufacture for a new model vehicle.

### **Cooperative Engineering Student**

**1979-1983**

Delco Moraine Division of General Motors

- While an undergraduate student, I worked alternating semesters at a variety of engineering assignments including research and development, product engineering, manufacturing engineering, and quality engineering.

## **TEACHING EXPERIENCE**

### **Associate Professor of Practice**

**2019 to present**

### **Assistant Professor of Practice**

**2014 to 2018**

### **Lecturer**

**2011-2013**

Mechanical Engineering,

School of Health and Rehabilitation Sciences, by courtesy

The Ohio State University, Columbus, Ohio

- Instructor and faculty advisor for Rehabilitation Engineering Senior Capstone Design course series involving students in Mechanical Engineering, Biomedical Engineering, Physical Therapy, and Occupational Therapy.
- Three student design teams selected as national design competition finalists, and patent filings are in process for two of these designs.
- Instructor in several Mechanical Engineering Design & Manufacturing courses, including undergraduate and graduate level students.
- Redesigned three courses to enhance learning and retention via engaged learning techniques.
- Collaborated with colleagues in the School of Medicine and former students to develop design projects with commercialization potential beyond the classroom setting and timeline.
- Design project selected for OSU Accelerator Award seed grant for commercialization.
- Faculty advisor for The Maker Club at Ohio State University

### **Adjunct Professor**

**2011-2013**

Columbus State Community College Columbus, Ohio

- Instructor for the calculus-based sequence of physics courses for students in Engineering and Physics.

### **Teaching Assistant**

**August 1995 to August 2000**

Washington University, St. Louis, Missouri

- Instructor for Senior Capstone Engineering Design, System Dynamics, and Mechanism Analysis.

### **Instructor**

**1988-1992**

Johnson County Community College Overland Park, Kansas

- Instructor for continuing education coursework in manufacturing and quality engineering methods and database applications.

## **RESEARCH EXPERIENCE**

### **Associate Professor of Practice**

**2019 to present**

### **Assistant Professor of Practice**

**2014 to 2018**

Mechanical Engineering, The Ohio State University, Columbus, Ohio

- Developed optimized sensor system for monitoring risk of pressure ulcers for wheelchair users. Patent for system is currently in prosecution, and the technology has been licensed to an outside startup company.
- Developed microcontroller based sensor system to measure vibration transmission to users of power wheelchairs.
- Developing biomechanical models and associated smart sensing data collection and analysis systems, to study the effect of wheelchair design parameters and user supports on users.
- Developing an optical motion capture system to study the biomechanics of insects when performing lifting and other occupational activities.
- Developed a tensile testing device to measure the stress-strain behavior of insect neck joints.

### **Post-doctoral fellow**

**2000-2004**

Biomedical Engineering, Washington University in St. Louis, St. Louis, Missouri

- Investigated the effects of a range of mechanical stimuli on mammalian cell cytoskeletal systems.
- Designed and developed a novel device for the combined application of Atomic Force Microscopy and Fluorescent Microscopy to study cells transfected with fluorescent cytoskeletal proteins.
- Developed computational models to study the effect externally applied loads on cellular structures and gene expression.

### **Graduate Research Assistant**

**1996 - 2000**

Mechanical Engineering, Washington University in St. Louis, Missouri

- Developed analytical and computational models of linear and nonlinear dynamic systems, including mechanical, biological, and manufacturing processes.
- Performed experimental analyses testing validity and accuracy of dynamic system models developed.
- Collaborated with the Boeing Company's Advanced Manufacturing Research Group and the University of Alabama Birmingham Cardiac Rhythm Management Laboratory in model development and experimental analyses.

## **STUDENTS ADVISED**

### **GRADUATE STUDENTS:**

- James Rowland, M.S., "Reducing Residential Space Conditioning Costs with Novel HVAC System Design and Advanced Controls", December, 2012.
- Recker, Derek, M.S. "Design, Development, and Analysis of a Single-Cylinder, Four-Stroke Propane Engine in an Educational Environment", May 2015.
- Sloan Zimmerman, M.S. "A Walker-Like Exoskeleton Reduces the Metabolic Cost of Walking", August 2016.
- Amy Koehler, M.S., "Biomechanical Modeling of Manual Wheelchair Propulsion: Force Capability Investigation for Improved Clinical Fitting Procedures," May 2017.
- Ryan Letcher, M.S., "SmartHub: A Low Cost Manual Wheelchair Fitness Metrics Tool for Clinicians, Researchers, and Wheelchair Users," May 2017.
- Matthew Brockman, M.S., "Spinal Cord Injury: Ulcer Development and Characterization of User-Mat Interface with Emphasis on Temperature and Pressure, May 2017.

- Akul Kakumani, M.S., “Design of a Tensile Tester to Test an Ant Neck Joint,” August 2017.
- Maura O’Neill, M.S., “Digital Rotating Unbalance Identification and Parametric Determination of Counterbalance Placement for Predictable Dynamic Behavior,” August 2017.
- Reece Martinez, M.S., “Development of a Situational Awareness System,” December 2017.
- Chenqi Xu, M.S., “Finite Element Analysis on Effects of Cushion Properties on Pressure Distribution and Contact Stress,” May 2018.

#### UNDERGRADUATE STUDENTS:

- L’Nard Tufts, undergraduate honors thesis, “Design of a Vibrational Measurement System for Power Wheelchairs,” May 2015.
- Ryan Letcher, undergraduate honors thesis, “Biomechanical Modeling of the Human Body for Application to Wheelchair Seating Systems,” May 2016.
- Alex Jones, undergraduate honors thesis, “Biomechanical Measurement System for Application in Wheelchair Seating Systems,” May 2016.
- Ruiqi Hu, undergraduate honors thesis, “Design and Calibration of a 3D Laser Scanner,” May 2017.
- Patrick Flannery, undergraduate honors thesis, “Development of an Integrated Platform for Modular Prototyping: the ‘Mod Duino’,” December 2017.
- Sarah Farou, undergraduate honors thesis, “Biomechanical Analysis of Controlled Ant Neck Movement Using High Speed Video Imaging,” May 2018.

#### **UNIVERSITY SERVICE**

- Committee member, University Committee on Academic Freedom and Responsibility, 2016-2018 academic years.
- Committee member, College of Engineering College Committee on Academic Affairs, Autumn 2016.
- Committee member, Undergraduate Studies Committee, Department of Mechanical and Aerospace Engineering, 2015-2016 and 2016-2018 academic years.
- Faculty advisor, The Maker Club at OSU, 2013-2014 and 2014-2015 academic years.
- Member, Faculty Community on Sustainability Across the Curriculum, 2012-2013 academic year.
- Committee member, University Ad-hoc Committee on Sexual Harassment Policy, 2017-2018 academic year.

#### **PUBLICATIONS**

Einstein, Noah, DiGiovine, Carmen, Metzler, Sandra, “SmartHub: a manual wheelchair data extraction and processing device”, Proceedings of the 2019 Rehabilitation Engineering Society of North America Conference, 2019.

Faieta, Julie, Einstein, Noah, Riefenberg, Jack, Metzler, Sandra, DiGiovine, Carmen, “SmartHub: Clinically Meaningful Wheelchair Propulsion Outcomes to Promote Client Centered Care”, Proceedings of the 2019 International Seating Symposium, 2019.

DiGiovine, Carmen P., Nahikian-Nelms, Marcia, Yankie, Matthew, Metzler, Sandra, “Pressure and Nutrition Factors on the Development of Pressure Injuries for Individuals with a Spinal Cord Injury”, *Proceedings of the 2018 International Seating Symposium*, 2018.

DiGiovine, Carmen P., Nahikian-Nelms, Marcia, Metzler, Sandra A., Brockman, Matthew, Yankie, Matthew The dispersion index as a metric for measuring pressure distribution on seat surfaces: a Pilot study, Proceedings of the 2017 Rehabilitation Society of North America Annual Conference, 2017.

Metzler, Sandra A., Lilly, Blaine W., “Implementation of a Novel Second-Year Mechanical Engineering Course to the Curriculum”, *Proceedings of the 2015 American Society for Engineering Education Annual Conference*, 2015-12972.

Wiechel, John, Metzler, Sandra, Freyder, Dawn, Kloppenborg, Nick, “Human Fall Evaluation Using Motion Capture and Human Modeling”, *Proceedings of the ASME 2013 International Mechanical Engineering Congress and Exposition*, 2013.

Morr, Douglas R., Wiechel, John F., Metzler, Sandra A., “Instrumentation in Support of Dynamic Digital Human Modeling”, *Handbook of Digital Human Modeling*, editor Vincent G. Duffy. Boca Raton: CRC Press, 2009.

Metzler, Sandra Anstaett, Bookwalter, Jeffrey C., Eiselstein, Nicholas P., “Motion Capture Applications in Forensic Injury Accident Reconstruction,” *Proceedings of the Society of Automotive Engineers Digital Human Modeling Annual Conference*, 2007.

Metzler, Sandra Anstaett, Bookwalter, Jeffrey C., Eiselstein, Nicholas P., “Biomechanics of Securing Vehicles for Transport,” *Proceedings of the European Human Factors and Ergonomics Society Annual Conference*, 2006.

Metzler, S.A., Yin, F.C., “Effect of Stretch & Shortening on Cytoskeleton & Cell Stiffness via Simultaneous AFM and GFP Imaging,” *Proceedings of the Biomedical Engineering Society Annual Conference*, 2003

Metzler, S.A., Hucker, W.J., Yin, F.C., “Effect of Mechanical Stretch and Shortening of Human Aortic Endothelial Cells,” *Proceedings of the Biomedical Engineering Society Annual Conference*, 2002

Hucker, W.F., Metzler, S.A., Yin, F. C., “A Numerical Analysis of the Mechanosensory Hypothesis of Brush Border Microvilli,” *Proceedings of the Biomedical Engineering Society Annual Conference*, 2002

Metzler, Sandra A., Yin, Frank C., Costa, Kevin, “Calibration of Atomic Force Microscope cantilevers via Hydrodynamic Loading,” *Proceedings of the Biomedical Engineering Society Annual Conference*, 2001

Bayly, Philip V., Metzler, Sandra A., Schaut, Adam J., Young, Keith A., “Theory of Torsional Chatter in Twist Drills: Model, Stability Analysis and Comparison to Test,” *American Society of Mechanical Engineers Journal of Manufacturing Science and Engineering*, 123, 552, 2001

Metzler, Sandra A., Bayly, Philip V., Young, Keith A., Halley, Jeremiah E., “Analysis and Simulation of Radial Chatter in Drilling and Reaming,” *Proceedings of DETC99ASME Design Engineering Technical Conferences*, 1999

Metzler, Sandra A., Bayly, Philip V., Reed, Sven, Ideker, Raymond E., Smith, William M., “Stability Analysis of Ventricular Tachycardia Using Discrete Dynamic Models,” *Proceedings of the 1997 Engineering in Medicine and Biology Society of the IEEE Annual Conference* (1997 Student paper competition regional winner)

## **PROFESSIONAL AFFILIATIONS**

Rehabilitation Engineering Society of North America (RESNA)

American Society of Mechanical Engineers (ASME) Biomedical Engineering Society (BMES)

Society of Automotive Engineers (SAE)

Human Factors and Ergonomics Society (HFES)

## **PROFESSIONAL REGISTRATIONS**

State of Ohio, Registration No. E-72221

## **AWARDS AND RECOGNITION**

Boeing Research Fellowship

Zonta International Amelia Earhart Fellowship

Selected as one of “Twelve Women You Should Know” in Central Ohio by Women for Economic Leadership and Development

Outstanding Mentor Award: FIRST Robotics Lego League

IEEE Engineering in Medicine and Biology Student Paper Competition Regional Winner

Michael J. Moran Award for Excellence in Teaching