Brent A. Griffin

Principal Perception Engineer at Agility Robotics
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www.griffb.com • [Google Scholar](#) • [GitHub](#) • [YouTube](#)

EDUCATION
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University of Michigan
Doctor of Philosophy: August 2016
Major: <u>Electrical Engineering: Systems</u>
Emphasis: Control Systems
Minor: Signal Processing
Advisor: Jessy Grizzle
GPA: 3.9
Dissertation: *Nonholonomic Virtual Constraints and Gait Optimization for Robust Robot Walking Control*

University of Nebraska-Lincoln
Master of Science: August 2012
Major: <u>Mechanical Engineering</u>
Minor: <u>Computer Science</u>
Advisor: Carrick Detweiler
GPA: 3.9
Thesis: *Automated Resonant Wireless Power Transfer to Remote Sensors from an Unmanned Aerial Vehicle*

University of Nebraska-Lincoln
Bachelor of Science: May 2008
Major: <u>Mechanical Engineering</u>

RESEARCH AREAS
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- **Robotics**
- **Active Perception**
- **Control**
- **Computer Vision**

PUBLICATIONS
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First author publications in all the top IEEE conferences for Computer Vision, Robotics, and Control.

- **Griffin, B.** & Gehrke M. RoboDepth: Robot-Supervised Monocular Depth Estimation. (*in preparation*)
- **Griffin, B.** ClickBot: Manipulating Objects using Pure Object Detection. *2022 IEEE International Conference on Intelligent Robotics and Systems (IROS).* (*under review*)
- **[C13] Griffin, B.** & Corso J. [Depth from Camera Motion and Object Detection](#). *2021 IEEE Conference on Computer Vision and Pattern Recognition (CVPR).* [[Video](#)][[GitHub](#)] (21% accept rate)
  * CVPR has an <u>h5-index of 356</u>, which is more competitive than all but three publications.
- **[C12] Griffin, B.** & Corso J. [Learning Object Depth from Camera Motion and Video Object Segmentation](#). *2020 European Conference on Computer Vision (ECCV).* [[Video](#)][[GitHub](#)] (27% accept rate)
- [C11] Florence, V., Corso, J., & **Griffin, B.** Robot-Supervised Learning for Object Segmentation. *2020 IEEE International Conference on Robotics and Automation (ICRA).*
- [P2] Kusano, K., Patel, S., **Griffin, B.**, & Corso, J. System and Method for Vehicle Lane Change Prediction using Structural Recurrent Neural Networks. US Patent (10,611,371), 2020.
- **[C10] Griffin, B.**, Florence, V., & Corso, J. [Video Object Segmentation-based Visual Servo Control and Object Depth Estimation on a Mobile Robot](#). *2020 IEEE Winter Conference on Applications of Computer Vision (WACV).* [[Video](#)][[GitHub](#)] (34.5% accept rate)

- **[C9] Griffin, B.** & Corso, J. BubbleNets: Learning to Select the Guidance Frame in Video Object Segmentation by Deep Sorting Frames. *2019 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*. [Video][GitHub] (**5.6%** oral accept rate, **Best Paper Award Finalist**)
- **[C8] Griffin, B.** & Corso, J. Tukey-Inspired Video Object Segmentation. *2019 IEEE Winter Conference on Applications of Computer Vision (WACV)*. [Tutorial Video][GitHub] (36% accept rate)
- **[P1] Griffin, B.**, Markov, M., & Dion, S. Athletic Timing Device. US Patent (9,782,661), 2017.
- **[J3] Griffin, B.** & Grizzle, J. Nonholonomic Virtual Constraints and Gait Optimization for Robust Walking Control. *International Journal of Robotics Research (IJRR)*, 2017. [Experiment Video]
- [B1] Detweiler, C., Eiskamp, M., **Griffin, B.**, Johnson, J., Leng, J., Mittleider, A., & Basha, E. UAV-Based Wireless Charging of Sensor Networks. In *Wireless Power Transfer Algorithms, Technologies and Applications in Ad Hoc Communication Networks*. Eds Nikoletseas, S., Yang, Y., & Georgiadis, A., 2016.
- [J2] Da, X., Harib, O., Hartley, R., **Griffin, B. A.**, & Grizzle, J. W. From 2D Design of Underactuated Bipedal Gaits to 3D Implementation: Walking with Speed Tracking. *IEEE Access, Volume 4.*
- [C7] Buss, B. G., Hamed, K. A., **Griffin, B. A.**, & Grizzle, J. W. Experimental Results for 3D Bipedal Robot Walking Based On Systematic Optimization of Virtual Constraints. *2016 IEEE American Control Conference (ACC).*
- **[C6] Griffin, B.** & Grizzle, J. Nonholonomic Virtual Constraints for Dynamic Walking. *2015 IEEE Conference on Decision and Control (CDC).*
- **[C5] Griffin, B.** & Grizzle, J. Walking Gait Optimization for Accommodation of Unknown Terrain Height Variations. *2015 IEEE American Control Conference (ACC)*. [Experiment Video]
- [C4] Buss, B. G., Ramezani, A., Hamed, K. A., **Griffin, B. A.**, Galloway, K. S., & Grizzle, J. W. Preliminary Walking Experiments with Underactuated 3D Bipedal Robot MARLO. *2014 IEEE International Conference on Intelligent Robots and Systems (IROS).*
- [J1] Mittleider, A., **Griffin, B.**, & Detweiler, C. Experimental Analysis of a UAV-based Wireless Power Transfer Localization System. *2014 International Symposium on Experimental Robotics (ISER).*
- [C3] Grizzle, J.W., Ramezani, A., Buss, B., **Griffin, B.**, Hamed, K. A., & Galloway, K. S. Progress on Controlling MARLO, an ATRIAS-series 3D Underactuated Bipedal Robot. *Dynamic Walking 2013.*
- [C2] Detweiler, C., **Griffin, B.**, & Roehr, H. Omni-Directional Hovercraft Design as a Foundation for MAV Education. *2012 IEEE International Conference on Intelligent Robots and Systems (IROS).*
- **[C1] Griffin, B.** & Detweiler, C. Resonant Wireless Power Transfer to Ground Sensors from a UAV. *2012 IEEE International Conference on Robotics and Automation (ICRA)*. [Exp. Video]

PROJECTS AWARDED AS PRIMARY INVESTIGATOR ($3.48 M)
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Low-Cost 3D Perception for Mobile Manipulation in Unstructured Human Environments
                                                              April 2021 – March 2024

- Funded by Toyota Research Institute ($1,851,143)
- Collaboration with David Fouhey (UMich), Justin Johnson (UMich), and
  Jason J. Corso (Stevens Institute for Artificial Intelligence)
- Integrate vision and control for robots to predict home layouts from a few images, but
  then continue to explore environments and self-teach to improve performance
- Learn vision-based controller for robots to perform rapid pick-and-place tasks using a
  single camera while collecting more data in its environment for learning
- Generate new annotations for local objects and actions using robot-supervised learning
- Low-cost 3D perception for full scene reconstruction from inputs ranging from 1 RGB
  image to multiple stereo pairs that is trainable from ordinary video and motion

3D Scenes   January 2021 – September 2022

- Funded by Ford Motor Company ($221,599)
- Collaboration with Jason J. Corso (Stevens Institute for Artificial Intelligence)
- Improve driver assistance and autonomous vehicle perception using a single camera
- Use video with odometry to learn metrically accurate self-supervised depth estimation
- Combine learned depth estimation with semantic segmentation to generate semantically
  labeled 3D scenes from a single image in real time
- Develop additional networks that improve 3D perception at night using thermal images
- Develop robot-supervised approach to automatically learn monocular depth estimation
  using autonomous robot motions in the robot's surrounding environment

Multiview Detection and Tracking to Improve Safety at Intersections
                                                    January 2021 – September 2021
- Mcity Tailored Project funded by DENSO Corporation ($83,000)
- Improve autonomous vehicle perception using external sensing infrastructure
- Develop custom intersection simulator with configurable and extensible multi-view visual
  training data using randomly generated vehicles and trajectories
- Improve performance over state-of-the-art detection and tracking methods with a
  custom network formulation that uses multiple camera viewpoints within an intersection

Interactive Learning for Manipulating Piles of Stuff   July 2018 – March 2021

- Funded by Toyota Research Institute ($1,326,000)
- Collaboration with Dmitry Berenson and Jason J. Corso (both UMich)
- Develop vision and control framework enabling robots to learn through interaction,
  completing tasks while observing the environment to understand pending objectives
- Develop robot-supervised approach to automatically generate new annotated training
  data that improves state-of-the-art segmentation and detection
- Learned perception and control framework for mobile manipulation won several TRI-
  sponsored HSR University Challenges against MIT, Stanford, Berkeley, and other schools

ACADEMIC EXPERIENCE
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Assistant Research Scientist   June 2017 – May 2022
Department of Electrical Engineering and Computer Science (Robotics Affiliation)
University of Michigan, Ann Arbor, MI
- Develop active perception-based feedback control for mobile robot manipulation
- Learn 3D reasoning on robot systems operating in unknown, complex environments
- Introduce state-of-the-art video object segmentation and detection methods through a rigorous investigation of temporal and spatial patterns in RGB and RGBD video
- Serve as a faculty adviser for the Multidisciplinary Design Program, which matches undergraduate and graduate students with industry sponsors for year-long projects
- Advise graduate students on research efforts involving perception, reasoning, and manipulation on physical robot systems

Research Fellow   August 2016 – May 2017
Department of Electrical Engineering and Computer Science
University of Michigan, Ann Arbor, MI
- Provide control expertise while creating new video segmentation methods as part of an effort to develop a unified framework for robot perception, reasoning, and control
- Implement unsupervised video object segmentation via novel distribution measures
- Perform research in a multi-university project for DARPA's Media Forensics program
- Develop state-of-the-art video manipulation techniques that maintain digital, physical, and semantic integrity to avoid detection (anti-forensics)
- Deliver standalone executable programs that perform video manipulations for the development of training data (consisting of > 50,000 videos) for forensic project teams

Graduate Research Assistant   August 2012 – August 2016
[Bipedal Robot Lab](#)
University of Michigan, Ann Arbor, MI
- Design feedback controllers that function well with uncertainty and validated control methods on a human-sized underactuated bipedal robot
- Using a single continuously-defined controller taken directly from optimization, the robot blindly traversed sloped sidewalks and parking lots, terrain covered with randomly thrown boards, and grass fields, all while maintaining human-level walking speeds
- Set a new precedent in robotics for walking efficiency in realistic environments
- Design and implement robot hardware modifications for better performance

Graduate Research Assistant   August 2011 – August 2012
Nebraska Intelligent MoBile Unmanned Systems (NIMBUS) Lab
University of Nebraska-Lincoln, Lincoln, NE
- Expand self-funded research to demonstrate wireless power transfer from unmanned aerial vehicles (UAVs) to remote sensor nodes
- Develop three novel circuit boards to: 1) transmit power by converting UAV's DC voltage to precise high frequency magnetic fields in resonant coils, 2) receive wireless power and convert to stable DC voltage for sensor charging, and 3) locate sensor nodes
- Research autonomous navigation for locating sensors and improving power transfer with respect to magnitude and efficiency
- Develop top-down controls and physics simulation for UAV

INDUSTRY EXPERIENCE
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Principal Perception Engineer   May 2022 – Present
Agility Robotics
- Develop and lead the perception group at Agility to build the future of robotics

Mechanical Design Engineer   March 2010 – August 2011
LI-COR Biosciences, Lincoln, NE
- Primary research and design work focus on mechatronic systems of highly sensitive and precise medical research instruments
- Identify and mitigate fundamental activities influencing accuracy and precision: thermal expansion from heat generation of moving and electrical components, abbe error from static and dynamic forces, and wear affecting the integrity of optical data
- Research, prototype, develop, and maintain products from infancy through streamlined production in interdisciplinary project teams
- Design and release multiple products as sole engineer on project
- Review other engineers' proposals and remedy problems in legacy instruments
- Initiate new program of design feedback meetings to provide additional perspective to individual work prior to significant development and time investment

Avionics Engineer   May 2008 – August 2009
Cessna Aircraft Company, Wichita, KS
- Create and implement mechanical designs for fixed-base flight simulators to support hardware-in-the-loop testing of aircraft avionics
- Provide actuated forces to pilot controls using strain gauges and encoders as feedback
- Design work includes part, assembly, and installation designs
- Perform mechanical designs using hand calculations, FEM analysis, and CATIA kinematics

Product Engineer Intern   September 2007 – February 2008
Nebraska Boiler, Lincoln, NE
- Evaluate performance calculations and design for pressure valves on boilers
- Assist with definition of design problem resolution, ISO 9000 standard technical specifications, and provide product support

Reliability Engineer Intern   May 2007 – August 2007
Spirit AeroSystems, Wichita, KS
- Increase capacity and decrease maintenance costs on milling machines using vibration analysis, cutter/adapter design, and metal removal rate calculations
- Calibrate a variety of machines using laser tracking and vector positioning software
- Present results to interdepartmental management team to increase productivity

Quality Assurance Engineer Intern   January 2007 – May 2007
Kawasaki, Lincoln, NE
- Ensure products met set quality standards
- Develop inspection procedures for production lines and product analysis
- Test products to be within design tolerances
- Contact suppliers to solve problems arising from all stages of production

AWARDS
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- Nominated for the Kenneth M. Reese Outstanding Research Scientist Award (2021)
- Best Paper Award Finalist, IEEE Conference on Computer Vision and Pattern Recognition (2019)
- Won First Place for the Inaugural TRI-sponsored HSR University Challenge (2018)
- Nominated for the ProQuest Distinguished Dissertation Award (2016)
- IEEE International Conference on Robotics and Automation (ICRA) Travel Award (2012)
- Charles J. Vranek Fund for Engineering Excellence (2007 – 2008)
- International Affairs Diversity/Discovery Study Abroad Scholarship (2006)
- Regents Scholarship (full tuition) (2003 – 2008)

INVITED TALKS
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- **Practical Robot Perception: Moving Objects using Vision with Action**, Amazon, Agility Robotics (April 2022)
- **Multiview Detection and Tracking to Improve Safety at Intersections**, Mcity (Nov. 2021)
- **Interactive Learning for Manipulating Piles of Stuff**, Stanford University (Jan. 2020)
- **Interactive Learning: Understanding the Environment through Manipulation and Vision**, *Plenary* Robotics Talk for TRI Joint University Workshop, University of Michigan (Jan. 2019)
- **Task-Oriented Active Perception and Motion Planning for Manipulating Piles of Stuff**, MIT (Dec. 2017)
- **Tools for Volumetric Segmentation and Grouping**, Tools and Technology Seminar for the Department of Computational Medicine and Bioinformatics, University of Michigan (Oct. 2017)
- **Control and Signal Processing Methods for Legged Locomotion**, Michigan Tech Research Institute (Mar. 2017)
- **Control Methods for Robust Robot Walking**, Oregon State University (Feb. 2017)
- **Underactuated Control Methods for Walking Over Unknown Terrain**, Oregon State University (Mar. 2015)

SELECTED MEDIA COVERAGE
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- **Robinly:** Interview discussing BubbleNets, Best Paper Award Finalist at CVPR 2019 (June 2019)
- **ECE News:** Computer vision: Finding the best teaching frame in a video for fake video fightback (June 2019)
- **Big Ten Network:** Michigan robot MARLO 'walks like a man' (Sep. 2015)
- **Popular Science:** Two-legged Robot with Human Feet Can Now Walk Independently (Jul. 2015)
- **EECS at Michigan:** Brent Griffin – Building Bipedal Robots (Jul. 2015)
- **Mathworks:** University of Michigan Develops Controls for Bipedal Robots with Model-Based Design (Oct. 2014)
- **Hackaday:** Wireless Power Transfer for Quadrotors (Jan. 2014)
- **IEEE Spectrum:** Quadrotors Turned Into Flying Wireless Battery Chargers (May 2012)
- **Hizook:** Wireless Power Transfer to Ground Sensors Using a UAV (Quadrotor) (Apr. 2012)

RELEVANT COURSEWORK

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Mechanical Engineering
- Robotics: Kinematics & Design
- Machine Design
- Continuum Biomechanics
- Advanced Mechatronics System Design

Computer Science
- Machine Learning
- Computer Vision
- Embedded Systems
- Robotics: Algorithms & Applications

Control Systems
- Control Systems Design
- Linear Systems Theory
- Linear Feedback Control
- Nonlinear Systems

COMPUTER SKILLS

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Python, ROS, TensorFlow, PyTorch, MATLAB, Simulink Real-Time, Linux, ANSYS, CATIA, Excel
Beginning: C++, C, LISP, Fortran, Creo

ACTIVITIES

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Associate Editor for IEEE International Conference on Intelligent Robots and Systems (2022)
Safety Committee Chair for the Ford Robotics Building (Aug. 2020 – Present)
Faculty Advisor for the UMich Multidisciplinary Design Program (Jan. 2017 – Dec. 2020)
Tau Beta Pi—The Engineering Honor Society (Member: 2006 – 2008; Treasurer: 2006 – 2007)
University of Nebraska Division I Rugby (2006-2008)
University of Nebraska Rifle Club (2006)
Engineering Study Abroad, Brazil (Summer 2006)

OTHER EDUCATION

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Applied Dimensional Metrology	2011
Geometric Dimensioning and Tolerancing Applications	2010
Fundamentals of Geometric Dimensioning and Tolerancing	2010
Private Pilot Certification	2009
Cessna Employees' Flying Club Ground and Flight School	2009