

# KEITH CAROLUS

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## EDUCATION

### **Computer Engineering, Bachelor of Science**

University at Buffalo | 2018

3.73 GPA

## EXPERIENCE

### **National Aeronautic and Space Administration (NASA)**

Deep Learning Intern | June 2018 – Present

- Developing spacecraft and docking target bounding box detectors based on state-of-the-art convolutional neural network models, e.g., YOLO v3
- Building configurable tool for image annotation for bounding box and keypoint labeling
- Developing keypoint detection models for relative pose estimation for autonomous navigation for spacecraft docking

### **Pixilica**

Consultant | May 2018 – Present

- Joining to consult on FireFly microboard computer design, machine learning on Lattice FPGAs, and machine learning extensions to the RISC-V instruction set architecture

### **University at Buffalo, Department of Computer Science and Engineering**

Undergraduate Research Assistant | September 2017 – May 2018

- Developed hardware simulator for custom instruction set architectures, targeting custom ISA, Smallpond (non-pipelined, RISC), based on Digilent Basys 3 Artix-7 FPGA for CSE443: Compilers and CSE490: Computer Architecture
- Winner of Best Hardware Hack, ACM Hack Night Finale 2018

### **Air Force Research Laboratory**

Griffiss Institute Intern | May 2017 – Present

- Developed highly accurate deep convolutional neural networks for SAR imagery classification
- Implemented adversarial example generation algorithms, improved model robustness

### **University at Buffalo, Department of Computer Science and Engineering**

Undergraduate Teaching Assistant | September 2015 – May 2018

- Supported CSE115 and CSE116: Introduction to Computer Science I and II, CSE341: Computer Organization, and CSE379: Introduction to Microprocessors
- Teach weekly recitations with approximately 100 students in attendance to review material and assist with projects
- Held office hours, provide review sessions, and invigilate examinations

### **Buffalo Neuroimaging Analysis Center**

Undergraduate Research Assistant | February 2015 – Present

- Develop high performance computing projects investigating multiple sclerosis pathology via magnetic resonance imaging
- Developing fully convolutional neural network based MRI lesion segmentation models
- Characterizing the timeline of Wallerian degeneration
- Tracking lesion progression according to vascular region

### Achievements

- Authored abstract accepted to the American Academy of Neurology Conference 2018
- Co-authored papers accepted to AJNR and Human Brain Mapping
- Won Nvidia academic support grant for graphics processing unit, \$1,200
- Won grant, *Convolutional neural network based automated MRI lesion segmentation in multiple sclerosis*, \$4,950
- Won grant for computer technology in the Kenneth M. Alford Medical Education Center, \$2,500
- Co-authored accepted conference abstracts to AAN, IMSCOGS, ECTRIMS-ACRIMS

### Empire Genomics

ISFTP Fellow | May 2016 – May 2017

- Full-stack web development of information management system for cytogenetic testing according to stakeholder requirements, integrated into company intranet (LAMP stack)
- Began developing multiple myeloma bioinformatics project relying on 1,000 patient NIH database with Dr. Jianxin Wang from the University at Buffalo Center for Computational Research

## SELECT PROJECTS

- Flight Data Recorder Interface Device project with KGB Aviation for CSE453: Hardware/Software Integrated Systems Design
- TaDa web app for productivity, a Trello/Google Calendar hybrid ([link](#)) for CSE442: Software Engineering
- First Place, UB CS Ed Week Demo competition, Arduino LED connect four with Android Bluetooth controller with Simran Singh

## TECHNICAL SKILLS

Platforms	Linux, Windows, OS X, Android
Languages	Python/IPython, Java, R, C/C++, Javascript
Applications	Jupyter Lab/Notebook, Eclipse, PyCharm, Android Studio
Machine learning frameworks	PyTorch, Keras, Tensorflow, Caffe
Hardware description, assembly	VHDL, MIPS and ARM assembly, Verilog
Other	Docker, Git, OpenCV, MATLAB, LaTeX, HTML/CSS, SQL, JUnit

## HONORS

- University at Buffalo Honors College graduation student speaker ([link](#))
- Selected member of University at Buffalo Department of Computer Science and Engineering Undergraduate Student Advisory Board
- Recommended and selected for Spark, the University at Buffalo's internationally competitive scholarship and fellowship preparation program

## PROFESSIONAL ACTIVITIES

- Openeuralink member
- Member of Eta Kappa Nu, the international electrical and computer engineering honor society of the IEEE
- Member of the American Physician Scientists Association
- Reviewer, IMPULSE Journal of Neuroscience
- Past Honors Peer Mentor for freshman engineering students
- Past member of Computational Sciences Club and the Association for Computing Machinery at the University at Buffalo, participated in skills building workshops and social events including UB Hacking

## VOLUNTEERING

### Cornell University Cooperative Extension

Mentor | February 2015 – November 2017

- Mentor for high risk youth in after school program entitled “Tech Wizards” at the Seneca Babcock Community Center

## JOURNAL PUBLICATIONS

Tom Fuchs, Michael Dwyer, Amy Kuceyeski, **Keith Carolus**, Xian Li, Sanjeevani Choudhery, Bianca Weinstock-Guttman, Dejan Jakimovski, Deepa Ramasamy, Robert Zivadinov, Ralph HB Benedict. *White matter tract network disruption explains reduced conscientiousness in multiple sclerosis*. Human Brain Mapping. May 8, 2018.

Tom Fuchs, **Keith Carolus**, Ralph RH. Benedict, Niels Bergsland, Deepa Ramasamy, Dejan Jakimovski, Bianca Weinstock-Guttman, Amy Kuceyeski, Robert Zivadinov, Michael G. Dwyer. *Longitudinal Impact of New Focal White Matter Damage on Localized Subcortical Gray Matter Atrophy in Multiple Sclerosis*. American Journal of Neuroradiology.

## PUBLISHED CONFERENCE ABSTRACTS

**Keith Carolus**, Tom Fuchs, Niels Bergsland, Deepa Ramasamy, Tomas Uher, Dana Horakova, Manuela Vaneckova, Eva Havrdova, Ralph H.B. Benedict, Robert Zivadinov, Michael G. Dwyer. *Accelerated subcortical atrophy following new lesion accrual in directly connected tracts is significant and appears limited to the first year*. American Academy of Neurology (AAN), Los Angeles, CA; April 21-27, 2018.

Tom Fuchs, Ralph HB Benedict, Sanjeevani Choudhery, Xian Li, **Keith Carolus**, Matthew Mallory, Alexander Bartnik, Devon Oship, Faizan Yasin, Deepa Ramasamy, Dejan Jakimovski, Bianca Weinstock-Guttman, Robert Zivadinov, Michael G. Dwyer. *Preservation of Functional Connectivity Moderates the Impact of White Matter Tract Disruption on Cognition in Multiple Sclerosis*. American Academy of Neurology (AAN), Los Angeles, CA; April 21-27, 2018.

Tom Fuchs, **Keith Carolus**, Sanjeevani Choudhery, Dejan Jakimovski, Niels Bergsland, Bianca Weinstock-Guttman, Robert Zivadinov, Ralph HB. Benedict, Michael G. Dwyer. *Whole Brain Tract Disruption Better Explains Cognitive Decline in Multiple Sclerosis than Total Lesion Volume*.ECTRIMS-ACRIMS, Paris, France; October 25-28, 2017.

Tom Fuchs, **Keith Carolus**, Dejan Jakimovski, Niels Bergsland, Deepa Ramasamy, Bianca Weinstock-Guttman, Ralph HB. Benedict, Robert Zivadinov, Michael G. Dwyer. *Longitudinal association between deep gray matter atrophy and lesion-based disruptions in connected white matter tracts*.ECTRIMS-ACRIMS, Paris, France; October 25-28, 2017.

Tom Fuchs, Caila Vaughn, Sanjeevani Choudhery, **Keith Carolus**, Dejan Jakimovski, Niels Bergsland, Bianca Weinstock-Guttman, Ralph HB. Benedict, Robert Zivadinov, Michael G. Dwyer. *Lesion-based disruption of connections between the amygdala and surrounding ipsilateral structures may be protective against fatigue in multiple sclerosis*.ECTRIMS-ACRIMS, Paris, France; October 25-28, 2017.

Tom Fuchs, Michael G. Dwyer, Shumita Roy, Sanjeevani Choudhery, Patrick Rooney, **Keith Carolus**, Niels Bergsland, Deepa Ramasamy, Dejan Jakimovski, Bianca Weinstock-Guttman, Robert Zivadinov, Ralph HB. Benedict. *Associations Between Low Conscientiousness and Cognitive Impairment in MS May Be Due to Shared Pathophysiology: Structural Network Disruption of Frontal Cortex Regions*.ECTRIMS-ACRIMS, Paris, France; October 25-28, 2017.

Tom Fuchs, Michael G. Dwyer, Shumita Roy, Sanjeevani Choudhery, Patrick Rooney, **Keith Carolus**, Neils Bergsland, Deepa Ramasamy, Dejan Jakimovski, Bianca Weinstock-Guttman, Robert Zivadinov, Ralph Benedict. *Elucidating the Pathophysiology of Conscientiousness in Multiple Sclerosis: Structural Network Disruption of Frontal Cortical Regions*. International Multiple Sclerosis Cognition Society (IMSCOGS), Dusseldorf, Germany; June 7-8, 2017.

Tom Fuchs, **Keith Carolus**, Ralph HB. Benedict, Niels Bergsland, Deepa Ramasamy, Robert Zivadinov, Michael G. Dwyer. *Subcortical gray matter atrophy is predicted by white matter lesions in directly connected tracts in multiple sclerosis*. American Academy of Neurology (AAN), Boston, MA; April 22-28, 2017.

## JOURNAL PUBLICATIONS IN REVIEW

Tom A. Fuchs, Ralph H. B. Benedict, Xian Li, Sanjeevani Choudhery, **Keith Carolus**, Matthew Mallory, Alexander Bartnik, Devon Oship, Faizan Yasin, Bianca Weinstock-Guttman, Dejan Jakimovski, Deepa Ramasamy, Robert Zivadinov, Michael G. Dwyer. Cognitive Reserve in Multiple Sclerosis is Partly Explained by Preserved Functional Connectivity within Networks of White Matter Tract Disruption. Human Brain Mapping.

## JOURNAL PUBLICATIONS IN PREPARATION

\*Tom A. Fuchs, \*Caila B. Vaughn, Ralph H. B. Benedict, Bianca Weinstock-Guttman, Sanjeevani Choudhery, **Keith Carolus**, Patrick Rooney, Kira Ashton, Deepa Ramasamy, Dejan Jakimovski, Robert Zivadinov, Michael G. Dwyer. Lower patient-report fatigue in multiple sclerosis is associated with increased disruption between the amygdala and surrounding ipsilateral structures.

\* Equally contributing authors

## CONFERENCE PAPERS IN PREPARATION

**K. Carolus**, M. Inkawich, and Q. Wu, "A Red Team, Blue Team Approach to Creating Resilient Deep Convolutional Neural Network SAR Imagery Classification Models," 2018.

## OTHER

- Comfortable Spanish speaker