

CURRICULUM VITAE

Joshua Jacobs, Ph.D.

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SUMMARY

I am an applied mathematician with a passion for data science, 3D visualization, mentorship, and team building. I believe in creating value through building effective professional relationships in a project-focused manner.

EDUCATION

PhD in Applied Mathematics **August 2012**

University of Washington

Dissertation:

Vortex Dynamics of Geostrophically Adjusted Density Perturbations
in Incompressible Stratified Fluids

Advisors:

Dr. Pascale Lelong

Dr. Randall Leveque

M.A. in Applied Mathematics **June 2005**

University of Minnesota Duluth

EXPERIENCE

Informatics Specialist II **April 2015 - Present**

Department of Neurological Surgery, Mayo Clinic, Rochester, MN **April 2017 - Present**

- Departmental data scientist.
- Consulted on and managed multiple interdisciplinary projects related to neurological disorders.
 - Automated acquisition of FitBit data from API (Python) to quantify recovery for spine surgery patients
 - Designed and implemented experiments analyzing mouse and human neuroimaging (Slicer, Python)

- Acquired and adapted techniques for genetic analysis of neurological tissues (GSEA, bioconductor, R)
- Collaborated across interdisciplinary teams to develop a \$1/2 M neurosurgical clinical registry, addressing an 8 month gap in patient reported outcomes with a \$1,000 solution.
- Prepared neurological data for [visualization](#) in a virtual reality environment (3D Slicer, Unity 3D)
- Mentoring PhD student on a project of Deep Learning (TensorFlow, NiftyNet) as applied to targeting on neuroimaging.
- Utilized effective networking resulting in grant pairings (of P.I.s), institutional committee meetings, and interdisciplinary collaborations

[Neural Engineering Lab](#), Mayo Clinic, Rochester, MN

August 2016 - April 2017

- Created web-application access to 10k research data files pertaining to deep brain stimulation, trajectory planning, and neurotransmitter detection (Python, Django).
- Developed a data analysis pipeline to deconvolve complex electrochemical signals for the analysis of material properties on hundreds of boron-doped diamond electrodes.
- Rapidly prototyped (2 weeks) stereotactic surgical planning software in the 3D Slicer framework (Python) used for deep brain stimulation research.

[Precision Neurotherapeutics Lab](#), Mayo Clinic, Phoenix, AZ

April 2015 to August 2016

- Negotiated with multiple sites and through appropriate committees to grant secure access to clinical imaging.
- Designed and deployed AGILE development cycle on cloud-distributed (AWS) tumor segmentation software (Python) to support a \$4M+ research program with 30+ users.
- Executed, analyzed, and [visualized](#) brain cancer models for submission to journals and conferences.

Research Associate

May 2013 – May 2015

Mathematical Neuro-Oncology Lab, Northwestern Memorial Hospital, Chicago, IL

- Extending the role of my previous position to managing the design of High Performance Computing experiments of mathematical cancer models.
- Maintenance, automation, and integration in a suite of applications turning clinical scans (MRI) into patient-specific models of glioblastoma multiforma and provide web enabled management of longitudinal patient data. This suite of applications (~180,000 lines) was written in five languages (Java, JavaScript, PHP, Python, Matlab) over the past seven years by ten previous developers.
- Use of biochemical radio tracer models for simulating clinical PET imaging.

Research Scientist III

March 2012 – May 2013

Kristin Swanson Lab, University of Washington, Seattle, WA

- Design of database application (Java) for HIPAA compliant transfer of patient data to national collaborators. Data consist of more than 2 Tb in more than 5 million files of patient scans.
- Management of critical core software enabling research of glioblastoma multiforme (Java, Python, Matlab, PHP).

- Algorithm analysis (MATLAB and Python) of mathematical models for tumor growth, (F-18) fluoromisonidazole (FMISO) uptake, and PET scan simulation.
- Management of the execution, data (>1 Tb), and analysis of mathematical tumor models on the Hyak high-performance computing cluster (1,428 nodes of 8 or more computing cores each) at the University of Washington.

Research Assistant

June 2007 – August 2010

Northwest Research Associates, Redmond Washington

- Employed familiarity with Finite Difference Methods, Fourier Methods, FORTRAN 77/90, MATLAB, Python, MPI, PBS scheduling, and unix-based platforms to provide design, execution, and analysis of parallel computational models of oceanic submesoscale phenomena.

Instructor of Mathematics

September 2005 – May 2006

Department of Mathematics and Statistics,
University of Minnesota Duluth, Duluth MN,

- Employed humor, programming expertise (C++, CGI), mathematical knowledge, and classroom management to the instruction of algebra, pre-calculus, and business mathematics.

Contract Programming

1996 – 2003

Object oriented design and database applications in ColdFusion, Object Pascale, Visual Basic, MS Access, Oracle, and PervasiveSQL to provide service for diverse clients in Winona, MN.

Badger Foundry

Database Administration using Visual Basic, MS Access, and PervasiveSQL for the management of foundry data.

Alumnae Association of the College of Saint Teresa

Use of MS Access and Visual Basic for managing Alumnae databases and delivery of scholarship funds.

Omni Engineering Services Inc.

Use of Delphi(Object Pascal), Visual Basic, MS Access, and SQL Server for applications for Ebenezer Social Ministries, Trane, and Surge Dairy Equipment.

Riverwise Inc.

Use of ColdFusion (PHP-like), MS Access, Oracle, and Visual Basic for the creation of a magazine subscription database and dynamic web sites for the Michigan Education Association.

SKILLS

Mathematical Modeling

Numerical Models of Partial Differential Equations, Geophysical Fluid Dynamics, Analysis of 3D Simulation Data, Separation of Numerical Artifacts from Features Representative of the Domain

Programming Languages[†]

Python, Java, Fortran 77/90, C/C++/C#, PHP, HTML, Perl, SQL

Tools[†]

TensorFlow, MATLAB, Git, Eclipse, VTK, 3D Slicer, VisIt, ParaView, Unity, MongoDB, AWS, MySQL, Hive, Message Passing Interface (MPI), Sun Grid Engine (SGE), Moab

Operating Systems[†]

Linux (and other Unix variants), Windows

†: Listed in descending order of proficiency and usage. The first being “most proficient” and “most used”.

SOFTWARE DEVELOPED

Education, research, employment, and hobby experience in the above skill set. A selection of contributions are as follows:

Recent work on [GitHub](#) with Unity 3D

[CLAWPACK](#)

April 2010

Contributed file I/O (NetCDF, Silo) to the Conservative Law Package for hyperbolic differential equations (Python, FORTRAN).

[For studying the definition of the derivative](#)

May 2010

Written with Dr. Daniel Heath, PLU, and purchased by Plato Learning (Java).

[Riemann Sums](#)

May 2010

Written with Dr. Daniel Heath, PLU, and purchased by Plato Learning (Java).

[Geometry Playground](#)

January 2010

Written with Dr. Daniel Heath, PLU, an Open Source compass and ruler application in 6 different geometries and translated into 10 different languages (Java).

PUBLICATIONS

0.1 Articles—Peer Reviewed

“Mathematical model of perineural tumor spread: a pilot study” **December 2017**

Joshua Jacobs, Stepan Capek, Robert Spinner, Kristin Swanson, *Acta Neurochirurgica*.

“A patient-specific computational model of hypoxia-modulated radiation-resistance in glioblastoma using 18F-FMISO PET”

December 2014

R. Rockne, M. Neal, A. D. Trister, **J. Jacobs**, A. Hawkins-Daarud, J. K. Rockhill, M. Mrugala, P. Kinahan, K.A. Krohn, K. Hendrickson, K.R. Swanson, The Royal Society Interface (December 2014), DOI: 10.1098/rsif.2014.1174.

“Geometry Playground”

September 2010

Heath, Daniel and **Joshua Jacobs**, Loci (September 2010), DOI: 10.4169/loci003567.

0.2 Articles—Accepted

“Improved Model Prediction of Glioma Growth Utilizing Tissue-Specific Boundary Effects”

2018

Joshua Jacobs, Russel Rockne, Andrea Hawkins-Daarud, Sandra Johnston, Pamela Jackson, Kristin Swanson, *Mathematical Biosciences*.

0.3 Articles—In Preparation

“Prediction of Hypoxic Fraction by Patient-Specific Models of Glioblastoma Multiforme”

Joshua Jacobs, Russ Rockne, Andrea Hawkins-Daarud, Pam Jackson, Robert Harrison, Paul Kinahan, Kristin Swanson.

0.4 Published Abstracts and Conference Papers

“Mathematically Modeling Perineural Spread Along Peripheral Nerves: A Pilot Study”

November 2016

J Jacobs, S Capek, R Spinner, K Swanson
Scottsdale AZ.

Society of NeuroOncology Annual Meeting;

“Simulating patterns of recurrence following ischemia in brain tumors”

November 2016

L Curtin, A Hawkins-Daruud, A Porter, **J Jacobs**, M Owen, K vander Zee, R Aoun, B Bendok, K Swanson
Society of NeuroOncology Annual Meeting; Scottsdale AZ.

“Presence of high ADC (low cellularity) tumor regions increases with diffuse appearance of GBMs on routine MRI”

November 2016

P Jackson, A Hawkins-Daruud, **J Jacobs**, H Malone, T Ung, J Kim, O Stringfield, L DeGiro-
lamo, E Benbassat, A Rosenberg, J Crisman, R Gatenby, S Partridge, P Canoll, K Swanson
Society of NeuroOncology Annual Meeting; Scottsdale AZ.

“Histologic evidence for a bio-mathematical model of glioblastoma invasion”

January 2017

A Hawkins-Daarud, L DeGiro-
lamo, **J Jacobs**, K Clark-Swanson, J Eschbacher, K Smith, P
Nakaji, L Baxter, J Karis, T Wu, J R Mitchell, J Li, L Hu, K Swanson AACR Engineering and
Physical Sciences in Oncology; Boston.

“Correlating magnetic resonance and molecular imaging using three dimensional untreated virtual control”

June 2016

J Jacobs, A Hawkins-Daarud, R Rockne, S Johnston, R Harrison, P Kinahan, K Swanson
AACR Engineering and Physical Sciences in Oncology; Boston.

“Glioblastoma Growth and Invasion Kinetics Correlate with ADC metrics”

April 2016

P Jackson, A Hawkins-Daarud, **J Jacobs**, T Ung, H Malone, J Kim, O Stringfield, L DiGiro-
lamo, E Benbassat, A Rosenberg, J Crisman, R Gatenby, S Partridge, P Canoll, K Swanson
ISMRM 23rd Scientific Meeting and Exhibition; 2016; Singapore.

Correlating A Patient-Specific Mathematical Model

Of Glioblastoma Proliferation-Invasion With Image-Guided Biopsies

November 2015

A. Hawkins-Daarud, H.R. Malone, T. Ung, A. Rosenberg, **J. Jacobs**, J. Bruce, P. Cannoll, K.R.
Swanson. In: SNO Annual Meeting 2015, Neuro-Oncology 17(suppl 5):v161-v161.

Improved Anatomical Model Prediction of

Glioma Growth Utilizing Tissue-Specific Boundary Effects,

April 2015

Joshua Jacobs, Andrea J. Hawkins-Daruud, Sandra K. Johnston, Russell C. Rockne, Kristin
R. Swanson. In: ASNR 53rd Annual Meeting; 2015; Chicago, IL, USA. 1508.

“Differing MRI Edema Profiles of Brain Metastases.”

April 2015

F Grady, P Jackson, **J Jacobs**, C Bridge, E Kokkinos, A Rosenberg, M Lester, P Kumthekar,
K Swanson: In: ASNR 53rd Annual Meeting; 2015; Chicago, IL, USA. 1508.

“Growth Kinetics of Contrast Enhancing Gliomas

Associate Invasive Growth with Seizure Presentation.”

November 2014

J. Juliano, R. C. Rockne, A. J. Hawkins-Daarud, P. Jackson, S. K. Johnston, **J. Jacobs**, E.

Kokkinos, A. Rosenberg, J. Crisman, C. Peters, D. Sharfman, M. Sondag, S. Badhe, M. Lester, T. Gallagher, P. Kumthekar, K. R. Swanson. Annual Meeting of the Society for Neuro-Oncology, 2014 (Miami, FL)—Platform Presentation

“Improved Anatomical Model Prediction of Glioma Growth Utilizing Tissue-Specific Boundary Effects” **November 2014**
Joshua Jacobs, Andrea Hawkins-Daarud, Sandra Johnston, Russel Rockne, Kristin Swanson

“Why Aren’t All Medial Gliomas Bilateral?” **November 2013**
Russel Rockne, Joshua Jacobs, Society of NeuroOncology Annual Meeting 2013, November 2013.

“Characteristics of Long-term Survivors in Glioblastoma.” **November 2013**
C. A. Bridge, A. L. Baldock, P. Kumthekar, P. Dilfer, S. K. Johnston, J. Jacobs, D. Corwin, L. Guyman, R. Rockne, A. Sonabend, M. Cloney, P. Canoll, K. R. Swanson. Annual Meeting of the Society for Neuro-Oncology, 2013 (San Francisco, CA)

“Integrating a 3D Spatiotemporal Glioma Model with a PET Simulation System to Create Patient-Specific FMISO Images: phantom studies” **November 2013**
Robert L. Harrison, Joshua Jacobs, Brian F. Elston, Adam M. Alessio, Darrin Byrd, Russell C. Rockne, Andrea Hawkins-Daarud, Mark Muzi, Sandra K. Johnston, Pamela R. Jackson, Kristin R. Swanson, Paul E. Kinahan; IEEE Medical Imaging Conference; 2013; Seoul, Korea.

“Factor Group Transformations on Escher Patterns” **August 2005**
Joshua Jacobs, Proceeds of the Bridges Conference, August 2005.

INVITED TALKS

University of Minnesota Duluth **April 2016**
“The Fisher-Kolmogorov Equation: Modeling Biological Invasions from Muskrats to Gliomas”.

Winona State University **November 2015**
“The Fisher-Kolmogorov Equation: Modeling Biological Invasions from Muskrats to Gliomas”.

University of Washington **September 2011**
“An Exploration of the Effects of Correlated Geostrophically Adjusted Internal Wave Breaking Events on Oceanic Lateral Dispersion”.

Annual PNW MAA Meeting **May 2010**
“Geometry Playground”, with Daniel J. Heath, PLU, and Ksenija Simic-Muller, PLU.

AGU Ocean Sciences Meeting **February 2010**
“Submesoscale lateral dispersion following spatially correlated wave-breaking events”, with M P Lelong, M A Sundermeyer.

CONFERENCES AND SYMPOSIUMS ATTENDED

SNUH-Mayo Clinic Joint Symposium in Movement Disorder **April 2017**
Rochester, MN.

Symposium on the Brain Initiative Rochester, MN.	April 2017
Society for NeuroOncology Scottsdale, AZ, Presented.	November 2016
Festival of Genomics Boston, MA.	June 2016
Engineering and Physical Sciences in Oncology Boston, MA, Presented.	June 2016
Symposium on the BRAIN Initiative Rochester, MN.	October 2015
Society for NeuroOncology Miami, FL, Presented.	November 2014
Society for NeuroOncology San Francisco, CA, Presented.	November 2013
Annual PNW MAA Meeting Seattle, WA, Presented.	May 2010
AGU Ocean Sciences Meeting Portland, OR, Presented.	February 2010

AWARDS AND SERVICES

Member of Mayo Clinic Data Science Program	Mayo Clinic	2017-2018
Track Lead for Mayo Clinic Machine Learning/Deep Learning Club	Mayo Clinic	2016-2018
Neurological Surgery Enterprise Research Committee	Mayo Clinic	2015-2017
Team Science Award	Mayo Clinic Neural Engineering Lab	2016
Chapter President of Society for Industrial and Applied Mathematics	University of Washington	2008-2009
Mathematics and Statistics Outstanding Teacher Award	University of Minnesota Duluth	June 2005

HOBBIES AND OTHER INTERESTS

Mycology and Mycoremediation
 Carbon Sequestration with Biochar
 Japanese Language
 Tai Chi