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*Curriculum Vitae*

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## William A Pruett, Ph.D.

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## Professional Profile

- Mathematician trained in representation theory, geometry, and combinatorics with a broad knowledge base in numerical analysis and algorithms
- Trained in cardiovascular, renal, and endocrine physiology
- In depth knowledge of mathematical modeling of physiological systems in an integrative setting
- Effective communicator, able to present big ideas to non-specialists
- Broad knowledge bases allowing easy communication with specialists in other fields
- Experienced programmer in Mathematica, HumMod/DES, Berkeley Madonna, LaTeX

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## Education

Doctorate of Philosophy in Mathematics, 2010 — Baylor University, Waco, TX

Bachelor of Science in Mathematics, *summa cum laude* 2005 — Millsaps University, Jackson, MS

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## Dissertation

Advisor: Markus Hunziker

Title: *Diagrams and reduced Decompositions for Cominiscule Flag Varieties and Affine Grassmannians*,  
advisor Markus Hunziker

- ❖ Developed graphical method for calculating generalized R-polynomials of minimal length quotient representation intervals corresponding to cominuscule flag varieties. The method allowed exhaustive proof of combinatorial invariance of Kazhdan-Lusztig polynomials, and therefore the geometry of cominuscule flag varieties.
- ❖ Combinatorial techniques developed in the finite cases were applied to the affine Grassmannians, enabling classification of rationally smooth points with graphical criteria.

## Professional Experience

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HC Simulation, LLC

Jackson, MS

*Chief Science Officer*

*May 2015 – present*

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- ❖ Responsible for development of Harvey, a cardio-renal model of human physiology for *in silico* clinical trials
  - ❖ Oversaw the development of a large scale data depot for calibrating and validating mathematical models, along with the database for storing and accessing this data
  - ❖ Awarded Phase I and II SBIR grants for in silico clinical trials development platform
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University of Mississippi Medical Center

Jackson, MS

*Postdoctoral researcher and Instructor*

*Aug. 2010 – present*

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- ❖ Developed a model of calcium homeostasis for HumMod. Duties included literature searches and reviews, extraction of differential-algebraic systems and validation.
  - ❖ Developed a population creation toolkit for calibrating HumMod to given racial, gender, age, or fitness segments of a population. Modules include MCMC and measure based sampling algorithms, surrogate methodologies, and binned clustering algorithms.
  - ❖ Realized a machine learning toolkit for deriving risk factors relative to a stipulated classifier.
  - ❖ Worked on a browser version of HumMod suitable for use in the undergraduate/graduate classroom. Participated in concept design, marketing, and testing of the product.
  - ❖ Created topological tools for analyzing large data sets, either model-derived or from clinical studies.
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## Teaching Experience

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University of Mississippi Medical Center

Jackson, MS

*Instructor*

*Aug. 2013 – Present*

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- ❖ Taught “Advanced Machine Learning” in the School of Data Science from 2018-present. Class was conducted in a standard lecture format.
  - ❖ Responsible for guiding the physiology graduate students through “Simulation of Physiological Mechanisms” (**Physio 744**) in 2014-2017.
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*Postdoctoral researcher*

*Aug. 2010 — July 2013*

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- ❖ I shared the teaching duties for the “Introduction to computational physiology” for medical students in 2011-2020. Class was conducted as question-and-answer series in small groups.
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- ❖ Responsible for guiding the physiology graduate students through “Simulation of Physiological Mechanisms” (**Physio 744**) in 2012-2013.

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## Baylor University

*Graduate Teaching Assistant*

Waco, TX

*Aug. 2006 – May 2010*

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- ❖ Teacher of Record for 3 hour class per semester (30-45 students) for eight semesters. Classes included precalculus, calculus I, and their Business school equivalents. I was responsible for every aspect of the class except writing the final exam (common final).
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## Research Interests

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- ❖ Lumped parameter modeling of cardiovascular and endocrine physiology, predictive modeling of complex systems, combinatorics of classical Weyl groups, knot polynomials.
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## Publications

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Speed JS, Pruett WA, Lirette ST, Cook JJ, Phillips CL, Grayson BE. Cardiovascular risk factors following vertical sleeve gastrectomy in black americans compared to white Americans. *Obes Surg*. 2021

Clemmer JS, Pruett WA, Lirette ST. Racial and sex differences in the response to first line antihypertensive therapy. *Front Cardiovasc Med*. 2020.

Pruett WA, Clemmer JS, Hester RL. Physiological Modeling and Simulation- Validation, Credibility, and Application. *Ann. Rev. Bioeng*. 2020.

Clemmer JS, Pruett WA, Hester RL, Lohmeier TE. Preeminent role of the cardiorenal axis in the antihypertensive response to an arteriovenous fistula: an *in silico* analysis. 2019.

Hester RL, Pruett WA, Clemmer JS, Ruckdeschel A. Simulation of integrative physiology for medical education. *Morphologie*. 2019.

Clemmer JS, Pruett WA, Hester RL, Iliescu R, Lohmeier TE. Role of the heart in blood pressure lowering during chronic baroreflex activation: insight from an *in silico* analysis. *Am J Physiol Heart Circ Physiol*. 2018.

Clemmer JS, Hester RL, Pruett WA. Simulating a virtual population's sensitivity to salt and uniphrectomy. *Interface Focus*. 2018.

Sims CR, Delima LR, Calimaran A, Hester R, Pruett WA. Validating the physiologic model HumMod as a substitute for clinical trials involving acute normovolemic hemodilution. *Anesth Analg*. 2017.

- Blair ET, Clemmer JS, Harkey HL, Hester RL, Pruett WA. Physiological mechanisms of water and electrolyte disturbance following transsphenoidal surgery. *World Neurosurg*. 2017.
- Clemmer JS, Pruett WA, Coleman TG, Hall JE, Hester RL. Mechanisms of blood pressure salt sensitivity: new insights from mathematical modeling. *Am J Physiol Reg Int Comp*. 2016.
- Pruett WA, Clemmer JS, Hester RL. Validation of an integrative mathematical model of dehydration and rehydration in virtual humans. *Physiol Reports*. 2016 November; 4(22)
- Pruett WA, Lohmeier TE. Illogical critiques of the pressure natriuresis theory of chronic hypertension, *Am J Hypertens* 2016. 29(12): 1332-1334.
- Pruett WA, Hester R. The creation of surrogate models for fast estimation of complex model outcomes. *PLoSOne*. 2016. <http://dx.doi.org/10.1371/journal.pone.0156574>
- Hester RL, Pruett WA. Use of Computer Simulations to Understand Female Physiology: Where's the Data? *Physiology (Bethesda)*. 2015 Nov;30(6):404-5.
- Zhang, S, Pruett WA, Hester R. Visualization and classification of physiological failure modes in ensemble hemorrhage simulation. in The Conference on Visualization and Data Analysis. 2015. San Francisco, CA.
- Pruett, WA, Hester RL. A decision support system predicting imminent cardiovascular shock. *Proceedings of the Interagency/Industry Training, Simulation and Education Conference*. 2014. Orlando, FL.
- Enright TJ, Hunziker M, Pruett WA, Diagrams of Hermitian type, highest weight modules, and syzygies of determinantal varieties in Symmetry: Representation Theory and its Applications: in Honor of Noel R Wallach (Progress in Mathematics 257). Birkhauser 2014.
- Pruett WA, Hester RL. Parathyroid hormone secretion by multiple distinct cell populations, a time dynamic mathematical model. *Physiol Rep* 2(2): e00231. 2014. doi 10.1002/phy2.231.
- K. Wu, J. Chen, W. A. Pruett, and R. L. Hester. HumMod Browser: An Exploratory Visualization Tool for the Analysis of Whole-Body Physiology Simulation Data. *IEEE Symposium on Biological Data Visualization*. October, 2013
- Pruett WA, Husband LD, Husband G, Dakhalla M, Bellamy K, Coleman TG, Hester RL. A population model of integrative cardiovascular physiology. *PLoS One* 8(9): e74329. 2013. doi 10.1371/journal.pone.007429
- Walters K, Burgreen GW, Hester RL, Thompson D, Lavallee D, Pruett WA, Ford-Green J. Cyclic breathing simulations in large scale models of the lung airway from the oronasal opening to the terminal bronchioles. *Proceedings of the ASME International Mechanical Engineering Congress and Exposition* (2012)

Walters K, Burgreen GW, Hester RL, Thompson D, Lavallee D, Pruett WA, Ford-Green J. Simulations of cyclic breathing in the conducting zone of the human lung. *Proceedings of the ASME Fluids Engineering Division Summer Meeting* (2012)

WA Pruett, TG Coleman, RL Hester, The apparent hysteresis in hormone-agonist relations. *J Theor Biol* (2012) **296**: 1-5.

RL Hester, AJ Brown, L Husband, R Iliescu, D Pruett, R Summers, TG Coleman, HumMod: A Modeling Environment for the Simulation of Integrative Human Physiology. *Frontiers in Physiology* (2011) **2**:12.

## Presentations

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MathFest (2003) *A link between Fermat and a conjecture of Landau*

Joint Mathematics Meeting (2004) *Divisibility properties of class numbers of composite irreducibles in  $F_q[T]$*

MathFest (2004) *Idempotent matrices over commutative principle ideal domains*

Joint Mathematics Meeting (2008) *Quotients of finite and affine Weyl groups by maximal parabolic subgroups and applications*

AMS Spring Southeastern Section Meeting (2009) *Generalized Young diagrams for Hermitian symmetric spaces*

Joint Mathematics Meeting (2010) *Projections of Ocneanu traces are Kazhdan-Lusztig R-polynomials*

Purdue Nutrition Department Seminar (2011) *Calcium homeostasis via the bone exchange pool*

UMMC Physiology Seminar (2011) *A mathematical model of calcium and phosphate homeostasis*

UMMC Physiology Seminar (2012) *Practical uncertainty: using experimental variance to validate and gain insight from mathematical models*

MS EPSCoR (2013): *HumMod: An Integrative Mathematical Model of Human Physiology*

Frontiers in Medical Devices [ASME/FDA] (2013): *Calibrating and analyzing a mathematical model of human circulation and its response to hemorrhage.*

MDIC/FDA (2014): *Predictive enrichment by systematic integration of multilevel computation with experimental results*

I/ITSEC (2014): *A decision support system predicting imminent cardiovascular shock*

Frontiers in Medical Devices [BMES/FDA] (2015): *Predicting non-response to renal denervation: an M&S approach*

International Congress of Cognitive Modeling (2016): *Integrative Physiological Modeling: Looking at a larger picture* (plenary)

Frontiers in Medical Devices [BMES/FDA] (2017) *The method of relational correlations to determine subpopulation characteristics.*

Medtronic (2017): *Understanding and predicting variation*.

FDA (2017): *Predicting nonresponse to renal denervation: an M&S approach*.

FDA (2017): *Coupling HumMod to Fluent: a tool for advanced patient-specific simulation*.

IMSH 2018 [Society for Simulation in Healthcare] (2018): *Predicting response to antihypertensive therapy in a broad population with physiological simulation*.

Integrating Machine Learning and Predictive Simulation: From Uncertainty Quantification to Digital Twins [Institute for Mathematics and its Applications] (2018): *Understanding and predicting physiological resistance with simulation and topological analysis*

Mississippi Academy of Sciences (2018): *Understanding and predicting variation*.

Virtual Physiological Human (2018): *Insights into mechanisms of resistance to renal denervation using topological analysis of simulation*

UMMC Physiology Seminar (2018): *Topological tools for elucidating systems response*

FDA-BMES (2019): *Digital Twins in Healthcare: an overview*

## Abstracts

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MathFest 2007: Rationally smooth Schubert varieties associated with  $A_n$

Experimental Biology (2011): A mathematical model of the calcium-bone exchange pool

EPSCoR Fall Meeting (2011): Modeling the calcium-bone exchange pool

Experimental Biology (2012): An integrative mathematical model of calcium homeostasis

AAMC (2012): Predicting Student Performance on USMLE Step 1

AAMC (2012): Building intuition in the classroom with integrative physiology simulations

Annual Academic Surgical Congress (2013): Center specific factors and racial disparities related to deceased donor renal transplant

Experimental Biology (2013): The assumption of heterogeneity in a mathematical model of the parathyroids leads to superior qualitative and quantitative response to complex stimuli

Experimental Biology (2013): Bifurcating response to hemorrhage in a population of mathematical models of the circulation

ASME/FDA (2013): Calibrating and analyzing a mathematical model of human circulation and its response to hemorrhage

IMSH/SSIH (2014): *Wagner: A real-time simulation for continuity of care training*

Experimental Biology (2014): *Understanding variation in salt sensitivity in HumMod, a human physiological simulator*

March 2021

Experimental Biology (2015): *Nonresponse to renal denervation in a simulated cohort of resistant hypertensive men*

BMES/FDA (2015): *Predicting non-response to renal denervation: an M&S approach*

IMAG (2015): *Rapid accurate estimation of physics based model outputs with surrogate techniques*

Experimental Biology (2016): *Predicting salt and diuretic sensitivity in a virtual population using topological data analysis*

VPH (2016): *Physiological sensitivity to salt and nephrectomy.*

VPH (2016): *Simulating physiological variability in human responses to renal denervation.*

## Academic Honors and Awards

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National Merit Scholarship 1994-1998

Ford Teaching Fellowship, Millsaps University, 2003-2005

President's Fellow, Baylor University, 2005-2010

Graduate Student Teacher of the Year, Mathematics Department, Baylor University, 2009

ASBMB Student/Postdoctoral Fellow Hill Day March 2011

ASBMB Graduate Student and Postdoctoral Fellow Advisory Committee 2012-2013

## Workshops

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ICCM 2016: Act-R Phi and a physiological model. With Chris Dancy.