# 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

## Education

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

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

## 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

## University of Mississippi Medical Center                    Jackson, MS
*Postdoctoral researcher and Instructor*              *Aug.  2010 – present*

- ❖ 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.

# Teaching Experience

## University of Mississippi Medical Center                    Jackson, MS
*Postdoctoral researcher*                             *Aug.  2010 — present*

- ❖ I shared the teaching duties for the introduction to computational physiology for medical students in 2011-2017.  Class was conducted as question-and-answer series in small groups.
- ❖ Responsible for guiding the physiology graduate students through *Simulation of Physiological Mechanisms* (**Physio 744**) in 2012-2017.

## Baylor University                                          Waco, TX
*Graduate Teaching Assistant*                        *Aug. 2006 – May  2010*

- ❖ 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).

# Research Interests

❖ Boolean dynamics, lumped parameter modeling of cardiovascular and endocrine physiology, topological data analysis, predictive modeling of complex systems, combinatorics of classical Weyl groups, knot polynomials.

## Publications

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 Jour Physiol Reg Int Comp. 2016.

Pruett WA, Clemmer JS, Hester RL.  Validation of an integrative mathematical model of dehydration and rehydration in virtual humans. Phys 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, Dakhlalla 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

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*

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*

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

ICCM (2016) *Integrative Physiological Modeling: Looking at a larger picture* (plenary)

BMES/FDA (2017) *The method of relational correlations to determine subpopulation characteristics.*

Medtronic (2017) *Understanding and predicting variation.*


## Abstracts

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*

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

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

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