Jason Swanson

University of Central Florida
Department of Mathematics
4000 Central Florida Blvd
P.O. Box 161364
Orlando, FL 32816-1364
Phone: (407) 823-0148
Fax: (407) 823-6253
Homepage: `http://math.swansonsite.com`

Education

Ph.D. in mathematics	**University of Washington**	**2004**

Dissertation title: *Variations of Stochastic Processes: Alternative Approaches*
Dissertation advisors: Krzysztof Burdzy and Zhen-Qing Chen

M.S. in mathematics	**University of Washington**	**2003**
B.S. in mathematics	**University of Washington**	**1998**

Graduated with distinction in mathematics

Employment

Associate Professor	**University of Central Florida**	**2012–present**
Assistant Professor	**University of Central Florida**	**2007–2012**
VIGRE Van Vleck Assistant Professor	**University of Wisconsin-Madison**	**2004–2007**

Faculty mentor: Thomas G. Kurtz

Teaching Assistant	**University of Washington**	**1999–2004**

Grants, Honors, and Awards

University of Central Florida Teaching Incentive Program Award	**2012**
Visiting Fellowship	**2010**

Isaac Newton Institute for the Mathematical Sciences, Cambridge, England

NSF Conference Grant 0957479	**2010–2012**
NSA Grant H98230-09-1-0079	**2009–2011**

VIGRE Van Vleck Assistant Professorship **2004–2007**
Department of Mathematics, University of Wisconsin-Madison

VIGRE Graduate Fellowship **2002–2004**
Department of Mathematics, University of Washington

Academic Excellence Award **2000**
Department of Mathematics, University of Washington

ARCS (Achievement Rewards for College Scientists) Fellowship **1999–2002**
Department of Mathematics, University of Washington

Gullickson Memorial Scholarship for outstanding achievement in math **1995**
Department of Mathematics, University of Washington

Publications

1. Tyler Gomez, Jason Swanson, Alexandru Tamasan. A filtering problem in stochastic tomography. Preprint, April 2016.

   Abstract: We consider the inversion problem of the Radon transform of an L^2-valued random variable Φ. Our main result concerns the determination of the conditional distribution of Φ on L^2 given the noisy observations $Y = R\Phi + \varepsilon W$, where R is the Radon transform, W is white noise, and $\varepsilon > 0$ is a small parameter.

2. Davar Khoshnevisan, Jason Swanson, Yimin Xiao, and Liang Zhang. Weak existence of a solution to a differential equation driven by a very rough fBm. Preprint, arxiv:1309.3613, May 2015.

   Abstract: We prove that if $f : \mathbb{R} \to \mathbb{R}$ is Lipschitz continuous, then for every $H \in (0\,,\frac{1}{4}]$ there exists a probability space on which we can construct a fractional Brownian motion X with Hurst parameter H, together with a process Y that: (i) is Hölder-continuous with Hölder exponent γ for any $\gamma \in (0\,,H)$; and (ii) solves the differential equation $dY_t = f(Y_t)\,dX_t$. More significantly, we describe the law of the stochastic process Y in terms of the solution to a non-linear stochastic partial differential equation.

3. David Nualart and Jason Swanson. Joint convergence along different subsequences of the signed cubic variation of fractional Brownian motion II. *Electron. Commun. Probab.*, 18:no. 81, 1–11, 2013. `arXiv:1303.0892`.

   Abstract: The purpose of this paper is to provide a complete description the convergence in distribution of two subsequences of the signed cubic variation of the fractional Brownian motion with Hurst parameter $H = 1/6$.

4. Krzysztof Burdzy, David Nualart, and Jason Swanson. Joint convergence along different subsequences of the signed cubic variation of fractional Brownian motion. *Probability Theory and Related Fields*, pages 1–36, 2013. `arXiv:1210.1560`.

   Abstract: The purpose of this paper is to study the convergence in distribution of two subsequences of the signed cubic variation of the fractional Brownian motion with Hurst parameter $H = 1/6$. We prove that, under some conditions on both subsequences, the limit is a two-dimensional Brownian motion whose components may be correlated and we find explicit formulae for its covariance function.

5. Jason Swanson. The calculus of differentials for the weak stratonovich integral. In Frederi Viens, Jin Feng, Yaozhong Hu, and Eulalia Nualart, editors, *Malliavin Calculus and Stochastic Analysis*, volume 34 of *Springer Proceedings in Mathematics & Statistics*, pages 95–111. Springer US, 2013. `arXiv:1103.0341v2`.

   Abstract: The weak Stratonovich integral is defined as the limit, in law, of Stratonovich-type symmetric Riemann sums. We derive an explicit expression for the weak Stratonovich integral of $f(B)$ with respect to $g(B)$, where B is a fractional Brownian motion with Hurst parameter 1/6, and f and g are smooth functions. We use this expression to derive an Itô-type formula for this integral. As in the case where g is the identity, the Itô-type formula has a correction term which is a classical Itô integral, and which is related to the so-called signed cubic variation of $g(B)$. Finally, we derive a surprising formula for calculating with differentials. We show that if $\mathbf{d}M = X\,\mathbf{d}N$, then $Z\,\mathbf{d}M$ can be written as $ZX\,\mathbf{d}N$ minus a stochastic correction term which is again related to the signed cubic variation.

6. Ivan Nourdin, Anthony Réveillac, and Jason Swanson. The weak Stratonovich integral with respect to fractional Brownian motion with Hurst parameter 1/6. *Electron. J. Probab.*, 15:2087–2116, 2010. `http://www.math.washington.edu/~ejpecp/`, `arXiv:1006.4238`

   Abstract: Let B be a fractional Brownian motion with Hurst parameter $H = 1/6$. It is known that the symmetric Stratonovich-style Riemann sums for $\int g(B(s))\,dB(s)$ do not, in general, converge in probability. We show, however, that they do converge in law in the Skorohod space of càdlàg functions. Moreover, we show that the resulting stochastic integral satisfies a change of variable formula with a correction term that is an ordinary Itô integral with respect to a Brownian motion that is independent of B.

7. Jason Swanson. Fluctuations of the empirical quantiles of independent Brownian motions. *Stochastic Process. Appl.*, 121(3):479–514, 2011. `http://dx.doi.org/10.1016/j.spa.2010.11.012`, `arXiv:0812.4102`

   Abstract: We consider n independent, identically distributed one-dimensional Brownian motions, $B_j(t)$, where $B_j(0)$ has a rapidly decreasing, smooth density function f. The empirical quantiles, or pointwise order statistics, are denoted by $B_{j:n}(t)$, and we are interested in a sequence of quantiles $Q_n(t) = B_{j(n):n}(t)$, where $j(n)/n \to \alpha \in (0,1)$. This sequence converges in probability in $C[0,\infty)$ to $q(t)$, the α-quantile of the law of $B_j(t)$. Our main result establishes the convergence in law in $C[0,\infty)$ of the fluctuation processes $F_n = n^{1/2}(Q_n - q)$. The limit process F is a centered Gaussian process and we derive an explicit formula for its covariance function. We also show that F has many of the same local properties as $B^{1/4}$, the fractional Brownian motion with Hurst parameter $H = 1/4$. For example, it is a quartic variation process, it has Hölder continuous paths with any exponent $\gamma < 1/4$, and (at least locally) it has increments whose correlation is negative and of the same order of magnitude as those of $B^{1/4}$.

8. Krzysztof Burdzy and Jason Swanson. A change of variable formula with Itô correction term. *Ann. Probab.*, 38(5):1817–1869, 2010. `http://dx.doi.org/10.1214/09-AOP523`, `arXiv:0802.3356`

   Abstract: We consider the solution $u(x,t)$ to a stochastic heat equation. For fixed x, the process $F(t) = u(x,t)$ has a nontrivial quartic variation. It follows that F is not a semimartingale, so a stochastic integral with respect to F cannot be defined in the classical Itô sense. We show that for sufficiently differentiable functions $g(x,t)$, a stochastic integral

$\int g(F(t), t)\, dF(t)$ exists as a limit of discrete, midpoint style Riemann sums, where the limit is taken in distribution in the Skorohod space of cadlag functions. Moreover, we show that this integral satisfies a change of variables formula with a correction term that is an ordinary Itô integral with respect to a Brownian motion that is independent of F.

9. Krzysztof Burdzy, Soumik Pal, and Jason Swanson. Crowding of Brownian spheres. *ALEA Lat. Am. J. Probab. Math. Stat.*, 7:192–205, 2010. `http://alea.impa.br/english/index_v7.htm`, `arXiv:1002.1057v1`

   Abstract: We study two models consisting of reflecting one-dimensional Brownian "particles" of positive radius. We show that the stationary empirical distributions for the particle systems do not converge to the harmonic function for the generator of the individual particle process, unlike in the case when the particles are infinitely small.

10. Jason Swanson. Variations of the solution to a stochastic heat equation. *Ann. Probab.*, 35(6):2122–2159, 2007. `http://dx.doi.org/10.1214/009117907000000196`, `arXiv:math/0601007`

    Abstract: We consider the solution to a stochastic heat equation. This solution is a random function of time and space. For a fixed point in space, the resulting random function of time, $F(t)$, has a nontrivial quartic variation. This process, therefore, has infinite quadratic variation and is not a semimartingale. It follows that the classical Itô calculus does not apply. Motivated by heuristic ideas about a possible new calculus for this process, we are led to study modifications of the quadratic variation. Namely, we modify each term in the sum of the squares of the increments so that it has mean zero. We then show that these sums, as functions of t, converge weakly to Brownian motion.

11. Teunis J. Ott and Jason Swanson. Asymptotic behavior of a generalized TCP congestion avoidance algorithm. *J. Appl. Probab.*, 44(3):618–635, 2007. `http://dx.doi.org/10.1239/jap/1189717533`, `arXiv:math/0608476`

    Abstract: The Transmission Control Protocol (TCP) is a Transport Protocol used in the Internet. Ott has introduced a more general class of candidate Transport Protocols called "protocols in the TCP Paradigm". The long run objective of studying this class is to find protocols with promising performance characteristics. This paper studies Markov chain models derived from protocols in the TCP Paradigm. Protocols in the TCP Paradigm, as TCP, protect the network from congestion by reducing the "Congestion Window" (the amount of data allowed to be sent but not yet acknowledged) when there is packet loss or packet marking, and increasing it when there is no loss. When loss of different packets are assumed to be independent events and the probability p of loss is assumed to be constant, the protocol gives rise to a Markov chain $\{W_n\}$, where W_n is the size of the congestion window after the transmission of the n-th packet. For a wide class of such Markov chains, we prove weak convergence results, after appropriate rescaling of time and space, as $p \to 0$. The limiting processes are defined by stochastic differential equations. Depending on certain parameter values, the stochastic differential equation can define an Ornstein-Uhlenbeck process or can be driven by a Poisson process.

12. Jason Swanson. Weak convergence of the scaled median of independent Brownian motions. *Probab. Theory Related Fields*, 138(1-2):269–304, 2007. `http://dx.doi.org/10.1007/s00440-006-0024-3`, `arXiv:math/0507524`

    Abstract: We consider the median of n independent Brownian motions, denoted by $M_n(t)$, and show that $\sqrt{n}\, M_n$ converges weakly to a centered Gaussian process. The chief difficulty is establishing tightness, which is proved through direct estimates on the increments of the median process. An explicit formula is given for the covariance function of the limit process. The limit process is also shown to be Hölder continuous with exponent γ for all $\gamma < 1/4$.

13. Teunis J. Ott and Jason Swanson. Stationarity of some processes in transport protocols. *SIGMETRICS Perform. Eval. Rev.*, 34(3):30–32, 2006. `http://dx.doi.org/10.1145/1215956.1215969`

    Abstract: This note establishes stationarity of a number of stochastic processes of interest in the study of Transport Protocols. For many of the processes studied in this note stationarity had been established before, but for one class the result is new. For that class, it was counterintuitive that stationarity was hard to prove. This note also explains why that class offered such stiff resistance.

Invited Conference Presentations

1. "A filtering problem in stochastic tomography", presented at the 3rd Workshop on Probability Theory and its Applications, Seoul National University, Seoul, Korea, December 13, 2016.

2. "A filtering problem in stochastic tomography", presented at the 11th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Special Session on Recent trends on PDEs driven by Gaussian processes with applications, Orlando, Florida, July 3, 2016.

3. "Joint convergence along different subsequences of the signed cubic variation of fractional Brownian motion," presented at the 7th International Conference on Stochastic Analysis and its Applications, Seoul National University, Seoul, Korea, August 10, 2014.

4. "Joint convergence along different subsequences of the signed cubic variation of fractional Brownian motion," presented at the AMS 2014 Southeast Spring Sectional Meeting, Special Session on Stochastic Processes and Related Topics, University of Tennessee, Knoxville, TN, March 22, 2014.

5. "The calculus of differentials for the weak Stratonovich integral," presented at the AMS 2012 Spring Central Section Meeting, Special Session on Stochastic Analysis, University of Kansas, Lawrence, KS, March, 2012.

6. "The calculus of differentials for the weak Stratonovich integral," presented at Foundations of Stochastic Analysis, Banff International Research Station, Banff, AB, September 2011.

7. "The calculus of differentials for the weak Stratonovich integral," presented at Ambit Stochastics – Theoretical Developments and Applications to Energy, Turbulence and Finance, Sandbjerg Estate (Aarhus University), Sønderborg, Denmark, September 2011.

8. "A change of variable formula with Itô correction term," presented at AMS 2011 Spring Southeastern Sectional Meeting, Special Session on Recent Developments in Stochastic Partial Differential Equations, University of Nevada, Las Vegas, NV, April 2011.

9. "The weak Stratonovich integral with respect to fractional Brownian motion with Hurst parameter 1/6," presented at the International Conference on Malliavin Calculus and Stochastic Analysis in Honor of Professor David Nualart, University of Kansas, Lawrence, KS, March 2011.

10. "A change of variable formula with Itô correction term," presented at the Stochastic Partial Differential Equations Programme, Isaac Newton Institute for Mathematical Sciences, Cambridge, UK, May 2010.

11. "Fluctuations of the empirical quantiles of independent Brownian motions," presented at the Purdue Workshop on Stochastic Analysis, Purdue University, West Lafayette, IN, September 2009.
12. "Fluctuations of the empirical quantiles of independent Brownian motions," presented at the 3rd International Conference on Stochastic Analysis and Its Applications, Beijing Institute of Technology, Beijing, China, July 2009.
13. "Fluctuations of the empirical quantiles of independent Brownian motions," presented at AMS 2009 Spring Southeastern Sectional Meeting, Special Session on Stochastic Dynamics, North Carolina State University, Raleigh, NC, April 2009.
14. "A change of variable formula with Itô correction term," presented at AMS 2008 Fall Southeastern Sectional Meeting, Special Session on Gaussian Analysis & Stochastic Partial Differential Equations, University of Alabama-Huntsville, Huntsville, AL, October 2008.
15. "A change of variable formula with Itô correction term," presented at 2nd International Conference on Stochastic Analysis and Its Applications, Seoul National University, Seoul, Korea, May 2008.
16. "The median of independent Brownian motions and other colliding particle models", presented at 32nd SIAM Southeastern-Atlantic Section Conference, Special session on Probability Theory and Applications, University of Central Florida, Orlando, FL, March 2008.
17. "Metastability and coupling of Markov processes," presented at International Conference on Stochastic Analysis and its Applications, University of Washington, Seattle, WA, August 2006.

Contributed Conference Presentations

1. "An application of the Markov mapping theorem to the study of metastability," presented at Markov Processes and Related Topics, University of Wisconsin-Madison, Madison, WI, July 2006.
2. "Weak convergence of the median of independent Brownian motions," presented at 30th Conference on Stochastic Processes and their Applications, University of California, Santa Barbara, CA, June 2005.
3. "The p-th variation of a Brownian martingale with an application to mathematical finance," presented at Summer Internship in Probability and Stochastic Processes, University of Wisconsin-Madison, Madison, WI, June 2003.

Other Conferences Attended

Seminar on Stochastic Processes 2013 **Mar 2013**
Duke University, Durham, NC

Seminar on Stochastic Processes 2012 **Mar 2012**
University of Kansas, Lawrence, KS

Seminar on Stochastic Processes 2011 **Mar 2011**
University of California, Irvine, CA

Seminar on Stochastic Processes 2010 **Mar 2010**
University of Central Florida, Orlando, FL

Seminar on Stochastic Processes 2009 **Mar 2009**
Stanford University, Stanford, CA

Seminar on Stochastic Processes 2008 **Apr 2008**
University of Delaware, Newark, DE

29th Midwest Probability Colloquium **Oct 2007**
Northwestern University, Evanston, IL

32nd Conference on Stochastic Processes and their Applications **Aug 2007**
University of Illinois at Urbana-Champaign, Urbana, IL

Conference on Stochastic Partial Differential Equations **Apr 2007**
Cornell University, Ithaca, NY

28th Midwest Probability Colloquium **Oct 2006**
Northwestern University, Evanston, IL

Seminar on Stochastic Processes 2006 **Mar 2006**
Princeton University, Princeton, NJ

27th Midwest Probability Colloquium **Oct 2005**
Northwestern University, Evanston, IL

Conference on Stochastic Control and Numerics **Sep 2005**
University of Wisconsin-Milwaukee, Milwaukee, WI

New Directions in Probability Theory **Aug 2005**
University of Minnesota, Minneapolis, MN

26th Midwest Probability Colloquium **Oct 2004**
Northwestern University, Evanston, IL

Seminar on Stochastic Processes 2004 **May 2004**
University of British Columbia, Vancouver, BC

5-day Workshop on Stochastic Partial Differential Equations **Sep 2003**
Banff International Research Station, Banff, AB

Seminar on Stochastic Processes 2003 **Mar 2003**
University of Washington, Seattle, WA

Conference on Probability and Conformal Mappings **Fall 2001**
Institut Mittag-Leffler, Djursholm, Sweden

University Seminars/Colloquia

University of North Carolina at Chapel Hill and Duke	**Nov 2014**
University of Alabama at Birmingham	**Apr 2013**
University of Washington	**Mar 2013**
University of Kansas	**Feb 2013**
University of Wisconsin-Madison	**Oct 2012**
University of Maryland, Baltimore County	**Apr 2012**
University of Washington	**Mar 2012**
University of Central Florida	**Sep 2011**
University of Central Florida	**Oct 2009**
University of Wisconsin-Madison	**Oct 2008**
University of Central Florida	**Mar 2008**
University of Washington	**Apr 2007**
Purdue University	**Mar 2007**
University of Kansas	**Feb 2007**
Tufts University	**Feb 2007**
Iowa State University	**Feb 2007**
University of Central Florida	**Feb 2007**
University of Wisconsin-Milwaukee	**Feb 2007**
University of Illinois at Chicago	**Dec 2006**
University of Wisconsin-Madison	**Apr 2006**
University of Illinois at Urbana-Champaign	**Apr 2006**
University of Washington	**Jan 2006**
University of Washington	**Mar 2005**
University of Wisconsin-Madison	**Dec 2004**

University of Wisconsin-Madison **Jul 2004**

University of Washington **Apr 2004**

University of California, San Diego **Jan 2004**

University of Washington **Feb 2003**

Courses Taught

University of Central Florida

MAA 6238: Measure and Probability I (Fall 2016, Fall 2015, Fall 2014, Spring 2014, Spring 2009)
A first graduate course on measure theoretic probability theory. Topics include measure and integration, probability measures, random variables, distribution functions, characteristic functions, and the standard modes of convergence: in L^p, in probability, in distribution, and almost surely.

MAP 4113: Probability, Random Processes and Applications (Fall 2016, Fall 2015, Spring 2015)
Axioms of probability and conditional probability, combinatorics, independence, random variables, joint distribution, expected value, conditional expectation, laws of large numbers, central limit theorem.

MAA 6245: Measure and Probability II (Spring 2016)
Martingales, Markov Processes, stopping times, Brownian motion, Weiner measure.

MAP 4640: Financial Mathematics (Spring 2016)
Binomial no-arbitrage pricing model, Martingales, Markov processes, capital asset pricing model, stopping times, American derivative securities, random walks, interest rates, fixed-income derivatives, futures.

MAA 4226: Advanced Calculus I (Spring 2015)
Limits, sequences, and continuity, differentiation and integration. Derivations of integrals. Infinite series and convergence. The Balzano-Weierstrass Theorem and the Heine-Borel Theorem. Extensions to n-dimensional Euclidean space.

MHF 3302: Logic and Proof in Mathematics (Fall 2014)
Basic mathematical logic. Methods of proof in mathematics. Application of proofs to elementary mathematical structures.

MAC 2312: Calculus with Analytic Geometry II (Spring 2014, Spring 2013, Spring 2012, Spring 2011, Spring 2010, Spring 2008)
Continuation of MAC 2311.

MAC 2311: Calculus with Analytic Geometry I (Fall 2013, Fall 2012, Fall 2011, Fall 2010, Fall 2009, Fall 2007)
The differential and integral calculus of algebraic and elementary transcendental functions with geometric and physical applications. Topics from analytic geometry include coordinate systems, vectors, lines, conic sections, transformations of coordinates, and polar coordinates. During the 2nd and 3rd semesters the topics also include sequences and series, Taylor series, and the differential and integral calculus for functions of several variables.

MAP 2302: Ordinary Differential Equations I (Fall 2013)
Methods of solution for first order equations. Linear equations. Laplace transforms. Series solutions. Selected applications.

MAA 6229: Analysis II (Spring 2012, Spring 2011)
Continuation of MAA 5228.

MAA 5228: Analysis I (Fall 2011, Fall 2010)
This is the first semester in a year-long, core qualifying course for incoming graduate students. Topics include real numbers, limits, differentiation, Riemann integrals, Riemann-Stieltjes integrals, calculus in $\mathbb{R}^n$, metric and normed spaces, contraction mapping theorem, inverse and implicit functions, Lebesgue measure and integration, topological spaces, Banach spaces, Hilbert spaces, bounded linear operators, distribution theory and the Fourier transform, general measure theory, and L^p spaces.

MAA 6306: Real Analysis (Spring 2010)
Sets, function spaces, Lebesgue measure, Lebesgue-Stieltjes measure, measurable functions, convergence notions, general measure and integration, Radon-Nikodym theorem.

MAC 2311H: Calculus with Analytic Geometry I, Honors (Fall 2008)
Differential and integral calculus, emphasizing understanding basic concepts and their applications. Students will complete projects on their own. For honors students from all disciplines.

MAC 2313: Calculus with Analytic Geometry III (Fall 2008)
Continuation of MAC 2312.

University of Wisconsin-Madison

Introduction to Probability Theory (Spring 2007)
A first course in probability at the undergraduate level, with topics including probability in discrete sample spaces, methods of enumeration (combinatorics), conditional probability, random variables, properties of expectations, the Weak Law of Large Numbers, and the Central Limit Theorem.

Introduction to Stochastic Processes (Fall 2006)
This course gives an introduction to Markov chains and Markov processes with discrete state spaces and their applications. Particular models studied include birth-death chains, queuing models, random walks and branching processes. Selected topics from renewal theory and Brownian motion are also included.

Basic Concepts of Mathematics (Spring 2006)
This course teaches the writing of rigorous mathematical proofs, by first covering some basic concepts of logic needed for mathematical proofs, and then working with those concepts on many examples from different areas of mathematics. The course also introduces the student to some of the abstract concepts of mathematics used in higher level math courses, such as equivalence relations, orderings, and a rigorous treatment of mathematical induction and the real numbers.

Directed Study (Fall 2005)
Supervised a senior undergraduate student in the study of Brownian motion and stochastic calculus.

Stochastic Analysis (Fall 2005)
A graduate course covering the foundations of continuous time stochastic processes, semimartingales and the semimartingale integral, Itô's formula, stochastic differential equations, stochastic equations for Markov processes, and applications in finance, filtering, and control.

An Introduction to Brownian Motion and Stochastic Calculus (Spring 2005)
An advanced undergraduate introduction to Brownian motion and stochastic calculus that does not require knowledge of measure theory.

The Theory of Single Variable Calculus (Fall 2004)
This course covers material in first and second semester calculus but it is intended to teach math majors to write and understand proofs in mathematics in general and in calculus in particular.

University of Washington

Introduction to ordinary differential equations
Linear Analysis and Introduction to Partial Differential Equations
Advanced Multivariable Calculus
Algebra in business and economics (teaching assistant)
First-year calculus (teaching assistant)
Undergraduate abstract algebra (teaching assistant)
Graduate complex analysis (teaching assistant)

Seminars and Conferences Organized

Probability and Statistics Seminar, University of Central Florida	2014-2015, 2008–2010
Qualifying examination preparation seminar, University of Central Florida	2012
Qualifying examination preparation seminar, University of Central Florida	2011
Seminar on Stochastic Processes 2010	Mar 2010
Probability Seminar, University of Wisconsin-Madison	2005–2007