

Jason F. Patrick

CONTACT INFORMATION

5247 Beckman Institute for Science and Technology
University of Illinois at Urbana-Champaign
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RESEARCH INTERESTS

Self-healing/sensing polymers and fiber-reinforced composites, multifunctional material systems, bioinspiration, computational mechanics, finite element analysis, structural health monitoring.

EDUCATION

University of Illinois at Urbana-Champaign, Urbana, Illinois USA

Ph.D., Civil Engineering (Structures), October 2014
GPA: 4.00

- Dissertation Topic: “Bioinspired Microvascular Self-healing in Polymers and Composites.”
- Advisor(s): Nancy R. Sottos, Scott R. White
- ★ *Certification in Computational Science and Engineering (CSE)*

North Carolina State University, Raleigh, North Carolina USA

M.S., Civil Engineering (Structures and Mechanics), May 2007
GPA: 3.88

- Thesis Topic: “Fundamental Characteristics of 3-D GFRP Sandwich Panels”
- Advisor: Sami H. Rizkalla

North Carolina State University, Raleigh, North Carolina USA

B.S., Civil Engineering, December 2004
GPA: 3.97 *summa cum laude*

HONORS AND AWARDS

Beckman Institute Postdoctoral Fellowship, UIUC, 2014
American Society of Composites Ph.D. Research Scholarship, UIUC, 2012
List of Teachers Ranked as Excellent by Their Students, UIUC, 2008
Structural Engineering Graduate Fellowship, UIUC, 2007
Civil Engineering Dean’s Graduate Fellowship, NCSU, 2005

RESEARCH EXPERIENCE

University of Illinois at Urbana-Champaign

• *Postdoctoral Fellow* **November 2014 - Present**
Interdisciplinary research and development of multifunctional fiber-reinforced polymer composites with bioinspired self-sensing and self-healing capabilities.

• *Graduate Research Assistant (PhD)* **August 2009 - October 2014**
Multidisciplinary research and development of self-healing polymers and fiber-reinforced composite materials for high performance structural applications.

◇ Laboratory Manager for Autonomous Materials Systems (AMS)

• *Graduate Research Assistant* **August 2007 - May 2009**
Computational mechanics development of mixed, variational multiscale finite element methods (FEM) equipped with a-posteriori error estimators.

North Carolina State University

• *Graduate Research Assistant (MS)* **January 2005 - December 2006**
Experimental characterization and computational analysis of mechanical properties for 3-D glass fiber-reinforced polymer (GFRP) composite sandwich panels.

• *Undergraduate Research Assistant (BS)* **May - August 2004**
NSF funded research award for investigation of carbon fiber-reinforced polymer confinement for strengthening and rehabilitation of concrete columns.

May - August 2003
Development of high strength concrete mix designs and experimental evaluation of flexural, compressive mechanical properties.

TEACHING EXPERIENCE

University of Illinois at Urbana-Champaign

★ *Graduate Certification in Foundations of Teaching*

• *AE 526 Advanced Manufacturing of Composites* **January - May 2015**
Co-lectured when faculty instructor was traveling, helped in grading homework assignments, and facilitated hands-on laboratory component for students' course projects.

• *CEE 360 Structural Analysis I* **January - May 2009**
Shared responsibilities with faculty instructor for creating homework assignments, exams, and administrative oversight of graders. Held regular office hours and review sessions in addition to maintaining course website.

• *MATH 231 Calculus II* **August - December 2008**
Taught bi-weekly discussion sessions and responsible for grading individual section quizzes, homework assignments, and holding regular office hours. Shared responsibility with faculty instructor(s) for grading exams.

North Carolina State University

• *CE 327 Reinforced Concrete Design* **January - May 2006**
Responsible for grading homework assignments and writing solutions sets.

• *CE 313 Mechanics of Solids* **January - May 2005**
Responsible for grading homework assignments, quizzes, and writing solution sets. Held regular office hours and weekly discussion sessions.

PUBLICATIONS

Patrick, J.F., Robb, M.J., Sottos, N.R., Moore, J.S., and White, S.R., Polymers with Autonomous Life-cycle Control, *Nature* 540:363-370 (2016).

Krull, B.P., Gergely, R.C.R., Santa Cruz, W.A., Fedonina, Y.I., **Patrick, J.F.**, White, S.R., and Sottos, N.R. Strategies for Volumetric Recovery of Large Scale Damage in Polymers, *Advanced Functional Materials* 26:4561-4569 (2016).

Krull, B.P., **Patrick, J.F.**, Sottos, N.R. and White, S.R., Automatic Optical Crack Tracking for Double Cantilever Beam (DCB) Specimens, *Experimental Techniques* 40(3):937-945 (2016).

Gergely, R.C.R., Pety, S.J., Krull, B.P., **Patrick, J.F.**, Doan, T.Q., Coppola, A.M., Thakre, P.R., Sottos, N.R., Moore, J.S. and White, S.R., Multidimensional Vascularized Polymers using Degradable Sacrificial Templates, *Advanced Functional Materials* 25:1043-1052 (2015).

Patrick, J.F., Hart, K.R., Krull, B.P., Diesendruck, C.E., Moore, J.S., White, S.R. and Sottos, N.R., Continuous Self-healing Life Cycle in Vascularized Structural Composites, *Advanced Materials* 26:4302-4308 (2014).

King, A.J., **Patrick, J.F.**, Sottos, N.R., White, S.R., Huff, G.H., and Bernhard, J.T., Microfluidically Switched Frequency Reconfigurable Slot Antennas, *IEEE Antennas and Wireless Propagation Letters* 12:828-831 (2013).

Patrick, J.F., Sottos, N.R. and White, S.R., Microvascular Based Self-Healing Polymeric Foam, *Polymer* 53:4231-4240 (2012).

Dong, H., Esser-Kahn, A.P., Thakre, P.R., **Patrick, J.F.**, Sottos, N.R., White S.R. and Moore, J.S., Chemical Treatment of Poly(lactic acid) Fibers to Enhance the Rate of Thermal Depolymerization, *Applied Materials & Interfaces* 4:503-509 (2012).

Esser-Kahn, A.P., Thakre, P.R., Dong, H., **Patrick, J.F.**, Vlasko-Vlasov, V.K., Sottos, N.R., Moore, J.S. and White, S.R. Three-Dimensional Microvascular Fiber-Reinforced Composites, *Advanced Materials* 23:3654-3658 (2011).

SUBMITTED
MANUSCRIPTS

Patrick, J.F., Krull, B.P., Garg, M., Mangun, C.L., Sottos, N.R. and White, S.R., Robust Sacrificial Polymer Templates for 3D Interconnected Microvasculature in Fiber-reinforced Composites, *Submitted* (2016).

PAPERS IN
PREPARATION

Patrick, J.F., Griffin, A.S., Mangun, C.L., Sottos, N.R. and White, S.R., Composite Delamination Healing via Thermally Remendable Polymer Interlayering, *In Preparation* (2017).

TECHNICAL
PRESENTATIONS

Patrick, J.F., Krull, B.P., Garg, M., Moore, J.S., Sottos, N.R. and White, S.R., Bioinspired Microvascular Networks for Multifunctional Composites. *20th International Conference on Composite Materials (ICCM)*, Copenhagen, DK, July, 2015.

Patrick, J.F., Krull, B.P., Garg, M., Moore, J.S., Sottos, N.R. and White, S.R., Bioinspired Microvascular Networks for Multifunctional Composites. *5th International Conference on Self-healing Materials (ICSHM)*, Durham, NC, June, 2015.

Patrick, J.F., Hart, K.R., Krull, B.P., Moore, J.S., White, S.R. and Sottos, N.R., Continuous Self-healing Life Cycle in Vascularized Structural Composites. *16th European Conference on Composite Materials (ECCM)*, Seville, ES, June, 2014.

Patrick, J.F., Hart, K.R., Krull, B.P., Moore, J.S., White, S.R. and Sottos, N.R., Self-healing in Woven Composite Laminates via Bioinspired Microvascular Networks. *4th International Conference on Self-healing Materials (ICSHM)*, Ghent, BE, June, 2013.

Patrick, J.F., Hart, K.R., White, S.R., Sottos, N.R. and Moore, J.S., Microvascular Based Self-healing 2D Woven Composites. *American Society for Composites (ASC) 27th Technical Conference*, Arlington, TX, October 2012.

Patrick, J.F., Sottos, N.R. and White, S.R., Self-healing Materials for Mitigation of Blast Damage. *Department of Homeland Security (DHS) Center of Excellence for Explosives Detection, Mitigation, and Response: Project Review*, Providence, RI, April, 2012.

US PATENT
APPLICATIONS

U.S. Serial No. 14/540,324 - Advanced Thermal Processing Techniques of “Sacrificial” PLA
Filed: November 13, 2014, *Published:* May 21, 2015.

U.S. Serial No. 13/721,801 - Self-Healing Composite Materials and Micro-Vascular Composites for Forming the Materials

Filed: December 20, 2012, *Published:* July 25, 2013.

U.S. Serial No. 13/416,002 - Micro-Vascular Materials and Composites for Forming the Materials

Filed: March 9, 2012, *Published:* March 14, 2013.

PROPOSAL
CONTRIBUTIONS

- Air Force Office of Scientific Research (AFOSR) - Phase II Small Business Technology Transfer (STTR), “Microvascular Composites for Novel Thermal Management Devices”, *Awarded:* **\$750k**, August 2015.
- Air Force Office of Scientific Research (AFOSR) - Phase I Small Business Technology Transfer (STTR), “Microvascular Composites for Novel Thermal Management Devices”, *Awarded:* **\$150k**, June 2013.
- University of Illinois at Urbana-Champaign (UIUC) - Aerospace Engineering Instructional Equipment Proposal, “Rapid Prototyping (3D printing) Equipment”, *Awarded:* **\$34k**, December 2012.
- National Aeronautics and Space Administration (NASA) - Technical Proposal, “Self-sealing composite sandwich structures”, *Awarded:* **\$480k**, June 2010.

PROFESSIONAL
MEMBERSHIPS

American Concrete Institute (ACI)

American Institute of Steel Construction (AISC)

American Society for Composites (ASC)

American Society of Civil Engineers (ASCE)

American Society of Mechanical Engineers (ASME)

Materials Research Society (MRS)

Society for Advancement of Material and Process Engineering (SAMPE)

PROFESSIONAL
EXPERIENCE

N.C. Department of Transportation - Materials and Testing Unit, Raleigh, NC.

Engineering Associate

January - August 2007

Conducted range of experimental qualification tests to evaluate structural materials for adherence to state-mandated acceptance criteria in addition to providing recommended guidelines.

Skanska USA - General Contracting Office, Winston-Salem, NC.

Summer Internship

May - August 2002

Handled typical commercial contracting operations including blueprint addendum, construction specifications, requests for information (RFI), project planning, estimating, and contract bidding.

Skanska USA - American Hebrew Academy, Greensboro, NC.

Summer Internship

May - August 2001

Performed on-site duties pertaining to aspects of commercial construction including surveying and building layout, subcontractor coordination, heavy equipment operation, and concrete placement.

CERTIFICATIONS

Registered Engineer in Training (EIT) - NC Board of Examiners for Engineers # A-21521

National Instruments Certified LabVIEW Associate Developer (CLAD)

Computational Science and Engineering (CSE) Doctoral Certification (UIUC)

Graduate Certification in Foundations of Teaching (UIUC)

SERVICE
ACTIVITIES

Team lead for Beckman Institute “Self-healing and Sustainability” TECH exhibition (2016)
Co-organizer of Conference on State-of-the-Art in Civil Engineering Structures/Materials (2015)
Coordinator/moderator of monthly Beckman Institute graduate student seminars (2014-2015)
Group lead for bi-annual Beckman Open House public exhibitions (2013, 2015)
Founder of Lake Raleigh annual clean up at NCSU Centennial Campus (2007)
Liaison for Girl Scout STEM visits to Constructed Facilities Laboratory (2006)

Reviewer for Scientific/Engineering Journals: Advanced Materials, Composites Part A & B, Composites Science and Technology, Journal of the Royal Society Interface, Polymer, Proceedings of the Royal Society A, Smart Materials and Structures.

SOFTWARE
EXPERIENCE

- Finite Element/Volume Analysis: ABAQUS, ANSYS Fluent, FEAP, PATRAN.
- Drafting/Graphics: Adobe CS Suite, Amira, AutoCAD, ImageJ, Simpleware, SolidWorks.
- Engineering/Mathematics: Maple, Mathematica, MATLAB, SAP2000.
- Programming: Fortran, HTML, LabVIEW.
- Word Processing: \LaTeX , MS Office.
- Operating Systems: Windows, Unix/Linux, Mac OS.

EXPERIMENTAL
TECHNIQUES

- **Fracture Testing:**
Mode-I: Double Cantilever Beam (DCB), Single-Edge Notch Bend (SENB).
Mode-III: Trouser Tear Test (ASTM D624).
- **Materials Characterization:**
Differential Scanning Calorimetry (DSC), Dynamic Mechanical Analysis (DMA).
Parallel Plate Rheometry, Thermogravimetric Analysis (TGA).
- **Mechanical Evaluation:**
Tension: ASTM D3039, ASTM D3822. *Compression:* ASTM C39, ASTM C873.
Flexure: ASTM C393, ASTM D7264. *Shear:* ASTM C273, ASTM D2344.
- **Microscopy/Spectroscopy:**
Confocal Raman Spectroscopy
Scanning Electron Microscopy (SEM)
Fluorescence Spectroscopy
X-ray Computed Microtomography (μ CT).

REFERENCES

Available upon request