

Thomas F. Boucher

Boston, MA

boucher@cs.umass.edu

<http://www.cics.umass.edu/~boucher>



Education

- 2017 (expected) Ph.D. Computer science, University of Massachusetts, Amherst, MA.
Dissertation “Transfer Learning with Mixtures of Manifolds”,
Advised by Sridhar Mahadevan and M. Darby Dyar.
- 2015 M.S. Computer science, University of Massachusetts, Amherst.
- 2011 M.S. Mathematics, University of Tennessee, Knoxville, TN.
Thesis “On Cyclotomic Primality Tests”, Advised by Luís R.A. Finotti.
- 2009 B.S. Mathematics, highest honors, University of Massachusetts, Amherst, MA.

Employment

- 2011- present Research assistant, University of Massachusetts, Amherst, MA.
• A member of NASA's Mars Science Laboratory (MSL) Team and a PhD candidate studying machine learning, artificial intelligence, and chemometrics and their applications to planetary science and scientific instrumentation. Research interests includes novel algorithms to better represent high-dimensional scientific data, transfer learning to correct for varying environmental/instrument conditions and to fuse heterogeneous data sources/formats, and better methods for regression of spectroscopic data. Funded currently by grants from NSF and NASA.
- 2012-2014 Software intern, IBM, CIO Lab (Watson Team), Cambridge, MA.
• Developed an original question classification system for the new Watson AI system, improving the old rule-based classifier to near-human level accuracy.
• Updated models of the first-generation Watson system, specifically the lexical answer type classifier, to handle new domains of data.
- 2009-2011 Teaching assistant, University of Tennessee, Knoxville, TN .
• Courses taught:
MATH 113: Mathematical Reasoning, New curriculum developed, including an original unit on historical and modern cryptography.
MATH 119: College Algebra, Taught multiple sections of an experimental on-line/in-class course and aided in assessment of the hybrid course model.
• Courses assisted: MATH 125: Basic Calculus, MATH 119: College Algebra.
- 2008-12 Software developer (part-time), Gravity Switch, Inc., Northampton, MA.
• Developed new features including search engine, threaded message board, CAPTCHA security system, and mod_rewrite system for the company's flagship product, a content management system.

- 2006-08 Software developer, Specialized Technology Resources, Inc., Enfield, CT.
- Team leader on two separate projects: a web-based quality assurance system and a client/server based auditing tool.
 - Designed and built a representational state transfer architecture for all corporate web services.
- 2001-2006 Sergeant, U.S. Marine Corps, Camp Lejeune, NC / Fallujah, IQ / Ramadi, IQ.
- Led a team of developers in creating programs from concept to deployment including an original smart tag-based information retrieval system, a production tracking system, a personnel management system, and a data warehouse system that stored every intelligence report created by the Marine Corps for Operation Iraqi Freedom (OIF).
 - Created an easy to use, searchable topographic data warehouse and web portal for storage and distribution of all Marine Corps imagery and map products during OIF.

Full Length Publications

- T. Boucher, M.D. Dyar, S. Mahadevan (2017) “Proximal Methods for Calibration Transfer”, *Journal of Chemometrics*, 31: 1-9.
- S. Giguere, T. Boucher, C. Carey, S. Mahadevan, M.D. Dyar (2017) “A Fully Customized Baseline Removal Framework for Spectroscopic Applications”, *Applied Spectroscopy*, in press.
- K. Lepore, C. Fassett, E. Breves, S. Byrne, S. Giguere, T. Boucher, et al. (2017) “Matrix Effects in Quantitative Analysis of Laser-Induced Breakdown Spectroscopy (LIBS) of Rock Powders Doped with Cr, Mn, Ni, Zn, and Co”, *Applied Spectroscopy*, 71: 600-626.
- S. Clegg, R. Wiens, R. Anderson, O. Forni, J. Frydenvang, J. Lasue, A. Cousin, V. Payré, T. Boucher, et al. (2017) “Recalibration of the Mars Science Laboratory ChemCam instrument with an expanded geochemical database”, *Spectrochimica Acta Part B: Atomic Spectroscopy*, 129:64-85.
- M.D. Dyar, S. Giguere, C. Carey, T. Boucher (2016) “Comparison of baseline removal methods for laser-induced breakdown spectroscopy of geological samples”, *Spectrochimica Acta Part B: Atomic Spectroscopy*, 126:53-64.
- M.D. Dyar, C. Fassett, S. Giguere, K. Lepore, S. Byrne, T. Boucher, C. Carey, and S. Mahadevan (2016) “Comparison of univariate and multivariate models for prediction of major and minor elements from laser-induced breakdown spectra with and without masking”, *Spectrochimica Acta Part B: Atomic Spectroscopy*, 123:93-104.
- T. Boucher, C. Carey, S. Giguere, M.D. Dyar, S. Mahadevan, S. Clegg, R. Wiens (2015) “Manifold learning for regression of Mars spectra”, *Proceedings of the 5th IJCAI Workshop on Artificial Intelligence in Space*, Buenos Aires, Argentina.
- C. Carey, T. Boucher, S. Giguere, S. Mahadevan, M.D. Dyar (2015) “Automatic Whole-Spectrum Matching”, *Proceedings of the 5th IJCAI Workshop on Artificial Intelligence in Space*, Buenos Aires, Argentina.
- S. Giguere, C. Carey, T. Boucher, S. Mahadevan, M.D. Dyar (2015) “An Optimization Perspective on Baseline Removal for Spectroscopy”, *Proceedings of the 5th IJCAI Workshop on Artificial Intelligence in Space*, Buenos Aires, Argentina.
- T. Boucher, C. Carey, M.D. Dyar, S. Mahadevan, S. Clegg, R. Wiens (2015) “Manifold preprocessing for laser-induced breakdown spectroscopy under Mars conditions”, *Journal of Chemometrics*, 29: 484–491.
- T. Boucher, C. Carey, S. Mahadevan, M.D. Dyar (2015) “Aligning mixed manifolds”, *Proceedings of the 28th Conference on Artificial Intelligence (AAAI)*, Austin, TX.
- T. Boucher, M. Ozanne, M. Carmosino, M.D. Dyar, S. Mahadevan, E. Breves, K. Lepore, S. Clegg (2015) “A study of machine learning regression methods for major elemental analysis of rocks using laser-induced breakdown spectroscopy”, *Spectrochimica Acta Part B: Atomic Spectroscopy*, vol. 107, pp. 1-10.
- C. Carey, T. Boucher, S. Mahadevan, P. Batholomew, M.D. Dyar (2015) “Machine learning tools for mineral recognition and classification from Raman spectroscopy”, *Journal of Raman Spectroscopy*, 46:894–903.

Y. Luo, T. Boucher, T. Oral, D. Osofsky, S. Weber (2014) “A study on crowdsourcing enterprise question collection and annotation”, Proceedings of the 9th International Conference on Language Resources and Evaluation, Reykjavik, Iceland.

Shorter Publications

T. Boucher, M.D. Dyar, C. Carey, S. Giguere, S. Mahadevan (2016) “Calibration Transfer for Spectroscopy in Space Science”, Proceedings of the 47th Lunar and Planetary Science Conference, no. 2784, the Woodlands, TX.

T. Boucher, M.D. Dyar, C. Carey, S. Giguere, S. Mahadevan, S. Clegg, R. Wiens (2015) “Calibration transfer of LIBS spectra to correct for Mars-Earth lab differences”, Proceedings of the 46th Lunar and Planetary Science Conference, no. 2773, the Woodlands, TX.

T. Boucher, M.D. Dyar, C. Carey, S. Mahadevan, A. Mezzacappa, N. Melikechi, (2014) “Recognizing the contribution of dust to ChemCam spectra of rocks and minerals on Mars”, Proceedings of the SciX conference, no. 377, Reno, NV.

Presentations

2017 Massachusetts Academy of Math and Science @ Worcester Polytechnic Institute, Worcester, MA, 25th Anniversary Celebration invited alumnus speaker at the symposium *Changing Our World*.

2016 SciX Conference, Minneapolis, MN, “The Future of Calibration Transfer”, invited speaker at the symposium *Rethinking Calibration*.

2015 5th IJCAI Workshop on Artificial Intelligence in Space, Buenos Aires, AR, “Manifold Learning for Regression of Mars Spectra”.

2015 MSL ChemCam Meeting, USGS, Flagstaff, AZ, “Towards the Next Generation of LIBS Calibration: Effective Use of Calibration Transfer”.

2014 SciX Conference, Reno, NV, “Recognizing the Contribution of Dust to ChemCam Spectra of Rocks and Minerals on Mars”.

2014 Mars Science All-hands Meeting, Caltech/JPL, Pasadena, CA, “Manifold Learning, Transfer Learning, and *Curiosity's* Learning”.

2013 MSL ChemCam Meeting, Delaware State Univ., Dover, DE, “Machine Learning for ChemCam”.

Posters

2016 Lunar and Planetary Science Conference, The Woodlands, TX, “Calibration Transfer for Spectroscopy in Space Science”.

2015 AAAI, Austin, TX, “Aligning Mixed Manifolds”.

2015 SciX Conference, Providence, RI, “A Convex Optimization Approach to Calibration Transfer”.

2014 SciX Conference, Reno, NV, “Using Manifold Embedding to Preprocess LIBS Spectra to Improve Regression Model Performance for Chemical Decomposition”.

2013 SciX Conference, Milwaukee, WI, “Manifold Regression of LIBS Data from Geological Samples for Application to ChemCam on Mars”.

Awards & Honors

- 2015 NASA Space Grant Fellowship, Massachusetts.
- 2015 Outstanding Synthesis Project Award, for the project “Improving Chemical Analyses on Mars using Manifold Learning”. Awarded by the School of Information and Computer Sciences annually to two PhD students. The synthesis project is the largest research requirement before admittance to candidacy.
- 2015 Analytical and Bioanalytical Chemistry (Springer) poster award at SciX-15 for “A Convex Optimization Approach to Calibration Transfer”.
- 2014 NASA Group Achievement award for work on the *Curiosity* rover.
- 2008-09 President & founder ACM Computer Science Club, Univ. of Massachusetts.
- 2007-09 Dean's List, all semesters, Univ. Of Massachusetts.
- 2004,05,06 Naval Achievement Medal, awarded three times for the development of mission critical intelligence software and for team leadership during Operation Iraqi Freedom.

Service

- 2016 NASA, Grant proposal reviewer for “Planetary Data Archiving, Restoration, and Tools”
- 2015 IJCAI, Session Chair, ML Track, High Dimensional Data Session
- 2015 IJCAI, Reviewer
- 2013-2016 Autonomous Learning Laboratory, Web master
- 2012 IEEE ICDL-Epirob, Reviewer
- 2009,10 Volunteer judge at FERMAT high school math competition at Univ. of Tennessee