

HEATHER D. COUTURE

Quantifying images for scientific discovery

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SUMMARY

Independent consultant & researcher using machine learning to develop custom solutions to unique and challenging image-based problems. Extensive experience with interdisciplinary R&D projects, including digital pathology, planetary science, and commercial media applications.

EDUCATION

University of North Carolina, Chapel Hill, NC *Ph.D. in Computer Science*, 2012–2018

- Advisor: Marc Niethammer
- Chancellor's Fellowship, 2012–2017
- Thesis: *Discriminative Representations for Heterogeneous Images and Genetic Data*

Carnegie Mellon University, Pittsburgh, PA *Master of Science in Robotics*, 2005–2006

- Advisor: David Wettergreen
- Thesis: *Automatic Rock Detection and Classification in Natural Scenes*

University of Waterloo, Waterloo, ON *Bachelor of Mathematics*, 2000–2005

- Honours Computer Science, Co-operative Program, Physics Minor
- Nortel Networks Undergraduate Scholarship, 2000–2005

TECHNICAL SKILLS

Languages	Python, C/C++, Matlab
Libraries	SciPy, scikit-learn, scikit-image, Keras, Theano, CUDA, OpenCV
Operating Systems	Linux, Unix, Windows
Development Tools	command-line development with GNU & Linux tools, version control
Development Skills	object-oriented design, concurrency, parallel computing, GPU
Image Analysis	color spaces, segmentation, feature extraction, texture, shape, medical imaging
Computer Vision	recognition, scene & object classification, feature learning, convolutional networks
Machine Learning	dimensionality reduction, PCA, clustering, classification, SVM, deep learning, regularization, optimization, performance analysis

INDUSTRY EXPERIENCE

Independent Consultant & Researcher, Oct. 2012 – present

Pixel Scientia Labs, Raleigh, NC

- Research, design, implementation, and evaluation of image analysis, computer vision, and machine learning algorithms.
- Specialty: image quantification for scientific applications.
- Selected projects:
 - 3D segmentation of human and mouse retina layers from optical coherence tomography.
 - Keyword prediction from movie and TV series metadata, including: pre-processing, cleaning, and transformation of data; imputation; classification with weak labels; development of performance metrics.

Image Computational Engineer, May 2007 – Aug. 2012

R&D Team Lead, July 2009 – Aug. 2012

DigitalSmiths, Durham, NC

- Research and development of image/video indexing and retrieval algorithms.
- Evaluation of new tools, prototyping algorithms, implementation of product components.
- Creation of metrics to quantify different aspects of an algorithm's performance.

- Collaboration with engineering teams to aid delivery of algorithms into production systems.
- Communication of methods and results to management.
- Projects include: scene classification of images and video (e.g., beach, forest, urban); face detection, tracking, and grouping; shot and scene boundary detection; clip retrieval using video signature.

ACADEMIC EXPERIENCE

Research Assistant, Aug. 2012 – Dec. 2018

Department of Computer Science, University of North Carolina at Chapel Hill, Chapel Hill, NC

- Quantitative image analysis of digital pathology for skin and breast cancer.
- Deep learning and traditional machine learning techniques.
- Integration of image and genomic information to form more powerful models.
- Application to diagnosis, prognosis, and subtyping of tumors.
- Prediction of tumor properties not previously known to be possible from H&E histology alone.

Research Technician, Oct. 2006 – Feb. 2007

Mars Space Flight Facility, Arizona State University, Tempe, AZ

- Research and development of methods for the detection and size estimation of craters in satellite images of Mars.
- Development of a system to detect rocks in high-resolution Mars satellite imagery; formation of rock distribution maps for selecting a landing site for the Phoenix spacecraft.

Research Assistant, Jan. – Aug. 2006

Robotics Institute, Carnegie Mellon University, Pittsburgh, PA

- Research, analysis, and development of methods for automatic detection and classification of rocks, including: detection of rocks with an accurately delineated boundary, characterization of rock shape, geologic classification with color, texture, and shape features.

ADDITIONAL TRAINING

Medical Imaging Summer School, Italy, July 2014

International Computer Vision Summer School, Italy, July 2011

SELECTED PUBLICATIONS

H. D. Couture, L. Williams, J. Geradts, S. Nyante, E. Butler, J. Marron, C. Perou, M. Troester, and M. Niethammer, "Image analysis with deep learning to predict breast cancer grade, ER status, histologic subtype, and intrinsic subtype," *npj Breast Cancer*, 2018.

H. D. Couture, J. S. Marron, C. M. Perou, M. A. Troester, and M. Niethammer, "Multiple instance learning for heterogeneous images: Training a CNN for histopathology," in *Proc. MICCAI*, 2018.

H. Dunlop, "Scene classification of images and video via semantic segmentation," in *Proc. CVPR Workshop on Perceptual Organization in Computer Vision*, 2010.

H. Dunlop, D. Thompson, and D. Wettergreen, "Multi-scale features for detection and segmentation of rocks in Mars images," in *Proc. CVPR*, 2007.

SELECTED PATENTS

H.D. Couture, et. al, "Methods, systems, and computer readable media for image analysis with deep learning to predict breast cancer grade, estrogen receptor (ER) status, histologic subtype, and intrinsic subtype," U.S. Patent Application 62/757,746, submitted Nov. 8, 2018.

H. Dunlop, and M.G. Berry, "Systems and methods for semantically classifying shots in video," U.S. Patent 8,311,344, filed Feb. 17, 2009, issued Nov. 13, 2012.