Curriculum Vitae

Michael Hawrylycz, Ph.D.

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EDUCATION

1994	Ph.D. Applied Mathematics, *Massachusetts Institute of Technology*, Boston, MA (Adviser: Gian-Carlo Rota)
1984	M.A. Mathematics, *Wesleyan University*, Middletown, CT
1981	B.A. Mathematics and Physics, *Colby College*, Waterville, ME

POSITIONS

2007-Present	Sr. Director, Informatics, Allen Institute for Brain Science, Seattle WA
2004-2007	Director, Informatics, Allen Institute for Brain Science, Seattle, WA
2002-2004	Director of Computational Biology, Regulome Corporation, Seattle WA
2000-2002	Director of Document Imaging, LizardTech Software/Celartem, Seattle WA
1997-2000	Senior Quantitative Analyst, UBS Warburg Dillon Reed, Chicago, IL, and London, England
1995-1997	Director of Basic Technology, Citibank Center for Adaptive Systems Applications Los Alamos, NM
1994-1995	Post-doctoral Fellow, Center for Non-Linear Systems, Los Alamos National Laboratory, Los Alamos NM
1993-1994	Instructor in Applied Mathematics, Massachusetts Institute of Technology
1984-1987	Staff Scientist, MIT Lincoln Laboratory, Lexington, MA

AWARDS

2007	Wired Magazine Rave Award for Science
2006	*Time* Magazine Award for Top 10 Medical Achievements
1996	Distinguished Performance Award, Los Alamos National Laboratory
1990	Chateaubriand Fellowship for Doctoral Research, Government of France

PROFESSIONAL MEMBERSHIPS

Society for Industrial and Applied Mathematics
American Statistical Association
Society for Neuroscience

PROFESSIONAL SERVICE

*International Neuroinformatics Coordinating Facility (*INCF), Lead of working group on Digital Atlasing Standards in the Rodent, http://www.incf.org/about/programs/atlasing

Review Editor, Frontiers in Neurogenomics

Reviewer, *Journal of Neuroscience, Nature Biotechnology, Physiological Genomics*

Consultant*, University of Washington,* Genome Sciences, Stamatoyannopoulos Lab

Program Committee – Bioimaging track http://www.iscb.org/ismb2010 ISMB 2010

INVITED PRESENTATIONS (elected)

Mathematics of the Allen Brain Atlas, Annual Meeting of the Pacific Northwest Section of the American Mathematical Society, University of Puget Sound, Tacoma, WA, April 1-2, 2005**.**

Mining gene expression in the Allen Brain Atlas, Genetic and Evolutionary Computation Conference (GECCO) 2006, Seattle, July 8-12, 2006. *Keynote address*.

Cognitive Computing Symposium, IBM Almaden Institute, May 10-11 2006

Analysis of Gene Expression Patterns in the Mouse Brain, University of Wisconsin, Applied Mathematics Seminar, Friday 13, 2006.

Addition, Microarrays, and Gene Discovery, National Institute for Drug Abuse NIDA/NIH, May 31-Jun 1, 2007

Organizing spatially mapped gene expression data in the mouse brain, Bioinformatics: The Interface Of Computation And Experiment , Gordon Research Conference, July 15-20, 2007, Proctor Academy, Andover, NH.

The Allen Brain Atlas Image Management, Janelia Farm Research Campus, Workshop on Image Management, August 27-28, 2007. *Leader of session on Image Annotation Tools*.

Building an Information Framework for Neuroscience, NIH/NIDA Workshop, October 19, 2007, Bethesda, Maryland.

Computational Neuroanatomy from Genome Scale Gene Expression Data in the C57Bl/6J Mouse Brain, Bio-Image Informatics: Biological Imaging, Computer Vision and Data Mining, 2008 Center for Bio-Image Informatics, UCSB, Jan 17-18, 2008.

INCF Task Force on Digital Brain Atlasing, Stockhom, Sweden, UCLA Los Angeles, Task Force Lead , Proceedings of 1st INCF Workshop on Mouse and Rat Brain Digital Atlasing Systems. Nature Precedings, <http://dx.doi.org/10.1038/npre.2007.1046.1>

Informatics of the Allen Brain Atlas and Applications to Addiction Genetics, Workforce Development and Collaboration in Addiction Genetics, National Institute of Drug Abuse, Satellite meeting at the American Society of Human Genetics, Sept 17, 2008. <http://www.ashg.org/2008meeting/>.

Genome wide neuroinformatics, The Brain Mind Institute, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland, Tuesday Feb 20, 2007

Mesoscale gene expression modes in the mouse brain, Systems Biology: Global Regulation of Gene Expression, Cold Spring Harbor, MA, March 27-30, 2008

The Allen Brain Atlas and Anatomic Gene Expression Atlas, University of Bologna, Italy, July 20, 2008

A Gene Expression Atlas of the Mouse Brain, The Blue Brain Project: Reverse-engineering biological intelligence, Satellite event of FENS 2008, Geneva, Switzerland, July 10-11, 2008.

An Anatomic Gene Expression Atlas of the Mouse Brain, Genome Informatics, co-chair with Angela DePace, image databases, Welcome Trust, Hinxton, England, September 10-14, 2008.

Bioimage informatics in 4D for a developmental gene expression atlas of the mouse brain, Howard Hughes Medical Research Campus, Janelia Farms, April 5-8, 2009, session chair, Cellular processes and models.

Bio21 Cluster Symposium: Computational Biology and Informatics: What are the Possibilities? Neuroinformatics of the Allen Brain Atlas, Melbourne, Australia, August 18-19, 2009

Keynote, UT-ORNL-KBRIN Bioinformatics , Summit 2010, Lake Barkley Resort, Cadiz, KY, Mar 19-21, 2010

WORKSHOPS AND TEACHING (selected)

Workshop co-organizer (with Sayan Pathak), *Computational Methods for Gene Expression Analysis in Neuroscience***, NIPS 2005, Whistler, BC, Dec 5- 9, 2005.

Instructor, *Neuroinformatics 2009*, Woods Hole, August 16 - 31, 2008

University of Washington, Computer Science, Guest lecturer CSE590cb, 2007-2009

Instructor, *3rd Canadian IBRO School in Neurodegeneration and Regeneration*, Vancouver, BC, May 24 – June 3, 2009

Co-Organizer (with Eugene Myers, Hanchuan Peng) Janelia Farms Meeting – Image Annotation: Turning Imags to Knowledge: Large Scale 3D Image Annotation and Management,

Co-organizer (with Robert Murphy) Bioimage Informatics 2010, Carnegie Mellon University, September 17-18, 2010

TRAINEES

Chi-Wai Lau (2007), Undergraduate Senior Thesis, co-advisor, Department of Computer Science, University of Washington

Sky Faber, (2007, 2008) Summer Intern, University of Washington, Computer Science

PUBLICATIONS

1. Campbell, M.F., Hoffmann, W.F, Thronson Jr, H.A. Niles, D. Nawfel, R., **Hawrylycz, M.** Far-Infrared Sources in Cynus X: An Extended Emission Complex at DR21 and Unresolved Sources at S106 and ON 2, *The Astrophysical Journal,* 262:550-557 (1982)

2. **Hawrylycz, M***.,* Dimension Independence in Exterior Algebra, *Proc. Natl. Acad. Sci. USA*, 92:2323-2327 (1995)

3. **Hawrylycz, M.***,* Geometric Identities in Invariant Theory, *Ph.D. Thesis,* MIT (1994)

4. **Hawrylycz, M.***,* Geometric Identities, Invariant Theory, and a Theorem of Bricard, *J. Algebra*, 169(1): 287-297 (1994)

5. **Hawrylycz, M.***,* Arguesian Identities in Invariant Theory, *Advances in Math.* , 122(1): 1-48 (1996)

6. Aggarwal A., and **Hawrylycz M.**, On Computing the Closet Boundary Point on the Convex Hull, *Info. Proc. Lett.,* 31:311-314 (1989)

7. **Hawrylycz, M.***,* A Geometric Identity for Pappus' Theorem, *Proc. Natl. Acad. Sci.* USA, 91: 2909 (1994)

8. **Hawrylycz, M.***,* The Lattice of Closure Relations on a Poset, *Algebra Universalis*, 30: 301-31 (1993)

9. Berman, K.A., and **Hawrylycz, M.**, Telephone Problems with Failures, *SIAM J. Algebraic and Discrete Methods* 7: 13-17 (1986)

10. **Hawrylycz, M.**, Jones, R., Makhankov V., and Prichard, D., The Risk and Survival of Economic Agents, *Random and Computational Dynamics* 5(4): 213-242 (1997)

11. Faber, V., Bradley, J., Brislawn, C.; Dougherty, R., **Hawrylycz, M**. Wavelet theory and its applications, M., Laboratory-Directed Research and Development (LDRD) project at the Los Alamos National Laboratory (LANL) A final report of a three-year DOE award, this report documents some of the first applications of wavelet techniques to image processing problems in what has become the emerging JPEG2000 compression standard. Report Numbe LA-UR--96-1887, DOE Contract Number,W-7405-ENG-36 1 (1996)

12. Mikheev, A., Vincent, L., **Hawrylycz, M**., Bottou, L., Electronic Document Publishing using DjVu*, Document Analysis Systems*, 480-490 (2002)

13. Dorschner MO, **Hawrylycz M,** Humbert R, Wallace JC, Shafer A, Mack J, Hall R, Goldy J, Kawamoto J, Sabo PJ, McArthur M, Stamatoyannopoulos JA.. High-throughput localization of functional elements by quantitative chromatin profiling. *Nature Methods* 1:219-225 (2004)

14. Sabo P, Humbert R, **Hawrylycz M**, Wallace J, Dorschner MO, Shafer A, McArthur M, Stamatoyannopoulos JA. Genome-wide identification of DNaseI hypersensitive sites using active chromatin sequence libraries. *Proc. Nat'l. Acad. Sci. USA* 101:4537-42 (2004).

15. Sabo PJ, **Hawrylycz M**, Wallace JC, Humbert R, Shafer A, Kawamoto J, Mack J, Hall R, Kohli A, Li Q, McArthur M, Stamatoyannopoulos JA. Discovery of functional non-coding elements by digital analysis of chromatin structure. *Proc. Nat'l. Acad. Sci. USA* 101:16837-16842 (2004)

16. The ENCODE Project Consortium. The ENCODE (ENCyclopedia Of DNA Elements) Project. *Science* 306: 636-40 (2004)

17. Yushkevich, P.,Avants, B.,Burstein, P.Ng, L., **Hawrylycz, M**.,Gee, J. Using MRI to build a 3D reference atlas of the mouse brain, *Proc Intl Soc Magn Res Med*, 13**:**2809 (2005)

18. Ng, L., **Hawrylycz, M**., and Haynor, D., Automated high-throughput registration for localizing 3D mouse brain expression using ITK, *The Insight Journal* Special Issue on ISC/NA-MIC/MICCAI Workshop on Open Source Software, MICCAI 1 (2005)

19. Sabo PJ, Kuehn MS, Thurman R, Johnson BE, Johnson EM, Cao H, Yu M, Rosenzweig E, Goldy J, Haydock A, Weaver M, Shafer A, Lee K, Neri F, Humbert R, Singer MA, Richmond TA, Dorschner MO, McArthur M, **Hawrylycz M**, Green RD, Navas PA, Noble WS, Stamatoyannopoulos JA. Genome-scale mapping of DNase I sensitivity in vivo using tiling DNA microarrays. *Nature Methods,* 3:511-8 (2006)

20. Pathak, S.; Lau, C.; Ng, L.; Kuan, L.; Sodt, A.; Kawal, R.; **Hawrylycz, M** , Mouse Brain Gene Expression Analysis Using Model Based Clustering. *Proceedings of Biomedical Imaging: Macro to Nano*. 3rd IEEE International Symposium, *ISBI* 1260:1263 (2006)

21. Ng L, Pathak SD, Kuan C, Lau C, Dong H, Sodt A, Dang C, Avants B, Yushkevich P, Gee JC, Haynor D, Lein E, Jones A, **Hawrylycz M**., Neuroinformatics for Genome-wide 3-D Gene Expression Mapping in the Mouse Brain., *IEEE/ACM Trans Computational Biology Bioinform.* 4(3):382-93 (2007)

22. Ng,L, Young, R., Pathak, S. Kuan, C, Sodt, A., Sutram, M., Lee, C.-K.,Dang, C., and **Hawrylycz, M.** (2007). NeuroBlast: a 3D spatial homology search tool for gene expression. Sixteenth Annual Computational Neuroscience Meeting Toronto, Canada*, BMC Neuroscience*

23. Pathak, S.,Lein, E., Smith, S., Haynor, D., **Hawrylycz, M**.,Gene expression detection and expression visualization in in situ hybridized cross-sectional images of the mouse brain, *SPIE Medical Imaging*, 5747:1112-1119 (2005)

24. Lein, E.**, Hawrylycz, M.**, et-al., (co-first author) Genome-Wide Atlas of Gene Expression in the Adult Mouse Brain, *Nature*, 445:168-176 (2007)

25. Birney E, Stamatoyannopoulos JA, Dutta A, Guigó R, Gingeras TR, Margulies EH, Weng Z, Snyder M, Dermitzakis ET, Thurman RE, Kuehn MS, Taylor CM, Neph S, Koch CM, Asthana S, Malhotra A, Adzhubei I, Greenbaum JA, Andrews RM, Flicek P, Boyle PJ, Cao H, Carter NP,

Clelland GK, Davis S, Day N, Dhami P, Dillon SC, Dorschner MO, Fiegler H, Giresi PG, Goldy J, **Hawrylycz M** et al., Identification and analysis of functional elements in 1% of the human genome by the ENCODE pilot project. *Nature,* 447: 7146: 799-816 (2007)

26. Lee CK, Sunkin SM, Kuan C, Thompson CL, Pathak S, Ng L, Lau C, Fischer S, Mortrud M, Slaughterbeck C, Jones A, Lein E, **Hawrylycz M.**, Quantitative methods for genome-scale analysis of in situ hybridization and correlation with microarray data., *Genome Biol.* 30;9(1) (2008)

27. Lau C, Ng L, Thompson C, Pathak S, Kuan L, Jones A, **Hawrylycz M**., Exploration and Visualization of Gene Expression with Neuroanatomy in the Adult Mouse Brain, *BMC Bioinformatics*. 9:153 (2008)

28. Thompson, C., Pathak, S., Jeromin, A., Ng, L., MacPherson, C., Mortrud, M., Cusick, A., Riley, Z. , Sunkin S., Bernard, A, Puchalski, R., Gage, F., Jones, A., Bajic, V., **Hawrylycz, M.**, Lein, E., Genomic Anatomy of the Hippocampus, *Neuron* (2008) **60** (6):1010-21

29. Ng, L., Bernard, A., Lau,C., Overly, C.,Dong H.-W., Kuan, L., Pathak, S., Sunkin, S., Dang, C., Bohland, J.,Bokil, H., Mitra, P., Puelles, L., Hohmann, J., Anderson, D., Lein, E., Jones A. **Hawrylycz, M**., An Anatomic Gene Expression Atlas of the Adult Mouse Brain, *Nature Neuroscience* (2009) 12(3): 356-362

30. Bohland, J. Hollis T., Cline J., Doyle J., Freed P., Greenspan, R., Haber S., **Hawrylycz, M.**, Herrera, D., Hilgetag C., Huang, J., Jones, A., Jones E.G., Karten, H., Kleinfeld, D., Kotter, R., Lester H., Lin J., Mensch B., Mikula, S., Panksepp, J., Price, J., Safdieh, J., Saper, C., Schiff, N., Schmahmann J., Stillman, B., Svoboda, K., Swanson, L.,Toga, A.W., Van Essen, D.C., Watson, J.D., Mitra, P.P.,   A proposed for a coordinated effort for the determination of brainwide Neuroanatomical connectivity in model organisms at a mesoscopic scale, PLOS Computational Biology, March 27, 2009

31. Thompson, C., Wilsor, J., Lee, C.-K., Pathak, S., Gerashchenko, D., Smith, K., Fischer, S., Kuan, C., Sunkin, S., Ng, L., Lau, C., **Hawrylycz, M**., Jones, A., Kilduff, T., Lein, E., Molecular anatomical signatures of sleep deprivation in the mouse brain, submitted, *Journal of Neuroscience*

32. Madisen, L., Zwingman, T., Sunkin, S.M.,Oh, S., Zariwala, H., Gu, H., Ng, L., Palmiter, R.D.,, **Hawrylycz, M**.,Jones, A.R.,   Lein, E.S.,, Zeng, H-K, A robust and high-throughput Cre reporting system for characterizing Cre-directed gene expression in the whole mouse brain, *Nature Neuroscience* , Nov 6, 2009

33. Ng L, Lau C, Sunkin SM, Bernard A, Chakravarty MM, Lein ES, Jones AR, **Hawrylycz M.**, Surface-based mapping of gene expression and probabilistic expression maps in the mouse cortex., *Methods*. 2009 Oct 7.

34. **Hawrylycz M**, Bernard A, Lau C, Sunkin SM, Chakravarty MM, Lein ES, Jones AR, Ng L., Areal and laminar differentiation in the mouse neocortex using large scale gene expression data., *Methods*. 2009 Sep 30.

35. Bohland, J., Bokil, H., Pathak A., Lee, C.-K., Ng, L., Lau, C., Kuan, C, **Hawrylycz, M**, Mitra PP, Clustering of spatial gene expression patterns in the mouse brain and comparison with classical neuroanatomy, *Methods*, 2009, Sep 3.

BOOK CHAPTERS

36. Invariant Theory *and the Projective Plane,* in Invariant Methods in Discrete and Computational Geometry, N. White Ed. Kluwer, *Invariant Methods In Discrete And Computational Geometry,* 308-325 (1995)

37. *The Monte Carlo Method in Mathematical Finance*, in Essays on the Future, in honor of Nick Metropolis, ed. S. Hecker, G.-.C. Rota, Birkhauser 83-105 (2000)

38. *Building a Better Brain Map*, *Genome Technology*, October 2006.

39. *3D Mouse Brain Reconstruction from Histology using a Coarse-to-Fine Approach*, Paul A. Yushkevich, Brian Avants, Lydia Ng, Michael Hawrylycz, Pablo Burstein, James C. Gee, Lecture Notes in Computer Science, Springer, Berlin, 4057: 230-237 (2006)

40. *The Allen Brain Atlas: Delivering Neuroscience to the Web on a Genome Wide Scale,* Dang C.*,* Sodt, A., Lau, C., Youngstrom, B., Ng, L, Kuan, L., Pathak, S., Jones, A., Hawrylycz, M., Lecture Notes in Computer Science, 4544:17-26 (2007)

41. *Spatial Gene Imaging in the Brain,* Invited Editor Introduction , L. Ng and M. Hawrylycz, Special Issue Elsevier Methods, 2009, Sept 3.