SHIKHAR UTTAM

Contact Information

Department of Computational and Systems Biology
University of Pittsburgh
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Research Interests

Primary focus: Optics and computational imaging, signal and systems, machine learning and imaging science ***applied to*** cancer systems biology, cancer epigenetics, early cancer detection and prediction and precision medicine.
Secondary focus: Computational biology and bioinformatics.
Other interests: Radar imaging and quantum information theory.

Immigration Status

Permanent Resident (Green card approved under outstanding professor and researcher category.)

Education

University of Arizona, Tucson, Arizona USA

Ph.D., Electrical Engineering, December 2010 (Minor: Mathematics)

- Dissertation Topic: "Compressive imaging for difference image formation and wide-field-of-view target tracking"
- Advisor: Nathan A. Goodman

M.S., Electrical Engineering, December 2006

- Thesis Topic: "Computer-aided classification of benign/malignant microcalcifications in digital mammograms"
- Advisor: Robin N. Strickland

Jamia Millia Islamia (Central University of the Govt. of India), New Delhi INDIA

B.S., Electrical Engineering, May, 2002

Current Position

Research Assistant Professor, (November 2016 – Present)
Department of Computational and Systems Biology,
University of Pittsburgh, Pittsburgh USA.

Employment

Research Associate, (July 2016–October 2016)
Department of Computational and Systems Biology, University of Pittsburgh.

Research Associate, (September 2013–June 2016)
Department of Medicine, University of Pittsburgh.

Postdoctoral Associate, (October 2010–August 2013)
Biomedical Optical Imaging Laboratory,
Depts. of Medicine and Bioengineering, University of Pittsburgh.
Lab Director: Dr. Yang Liu

Honors and Awards

Travel Award, *Find Your Inner Modeler* workshop, University of Illinois at Chicago, Chicago, Illinois; August 16-17, 2018.

Pitt Innovator Award, November 2014. (University of Pittsburgh award for technology innovation and translation.)

Director's Award for Scientific Excellence, University of Pittsburgh Cancer Institute (UPCI); for pre-clinical cancer research (2013).

Graduate Tuition Scholarship Recipient, University of Arizona, (August 2006 - May 2010).

Outstanding Teaching Assistant Award, College of Engineering, University of Arizona. (Chosen from all engineering departments within the University of Arizona (2005-2006).)

Grants

Ongoing Research Support
Grant: R01CA232593-01A1 (April 2019 – March 2024)
Grant type: Multi-PI RO1 (Principal Investigators (PIs): Yang Liu and Shikhar Uttam)
Grant performance specs: **Impact score: 19** and **Percentile: 3**%
Grant title: Three dimensional nanoscale nuclear architecture mapping based taxonomy of precursor lesions for predicting colorectal cancer risk.
Primary assignment: National Cancer Institute, National Institutes of Health.
Role: PI

Completed Research Support
Grant: R01CA185363 (May 2014 – April 2019)
Grant title: (PQC2) Nanoscale changes in 3D nuclear architecture during breast tumorigenesis.
Funding agency: National Cancer Institute, National Institutes of Health.
Role: Co-investigator

Grant: R01EB016657 (April 2013 – March 2018)
Grant title: Novel Nanoscale Single-Cell Analysis of Exfoliative Cytology.
Funding agency: National Institute of Biomedical Imaging and Bioengineering, National Institutes of Health.
Role: Co-investigator

Book Chapters

S. Uttam, "Introduction to quantum information processing" in Quantum information processing and quantum error correction, an engineering approach (Academic Press, Oxford, 2012)

S. Uttam, "Quantum information theory" in Quantum information processing and quantum error correction, an engineering approach (Academic Press, Oxford, 2012)

Peer-reviewed Journal Publications

1. **S. Uttam**, A. M. Stern, S. Furman, F. Pullara, D. Spagnolo, L. Nguyen, A. H Gough, C. Sevinsky, F. Ginty, D. L. Taylor, S. C. Chennubhotla, "A spatial analytics computational and systems biology platform predicts risk of colorectal cancer recurrence and identifies emergent spatial domain networks associated with recurrence," (2019). [*Under Review*] **bioRxiv** 635730; doi: https://doi.org/10.1101/635730
2. **S. Uttam**, J. G. Hashash, J. LaFace, D. Binion, M. Regueiro, D. J. Hartman, R. E. Brand, and Y. Liu,"Three-dimensional nanoscale nuclear architecture mapping detects the presence of colorectal neoplasia in patients with inflammatory bowel disease colitis from rectal biopsies," Cancer Prev. Res. (2019). [*In Press*]
3. E. Fouquerel, R. Barnes, **S. Uttam**, S. Watkins, M. Bruchez, and P. L. Opresko,"Chronic oxidative guanine base damage at telomeres induces telomere crisis," Molecular Cell; 75(1): 117-130 (2019).
4. J. Xu, H. Ma, J. Jin, **S. Uttam**, R. Fu, Y. Huang, and Y. Liu, "Super-resolution imaging of higher-order chromatin structures at different epigenetic states in single mammalian cells," Cell Reports; 24(4): 873-882 (2018).
5. **S. Uttam** and Y. Liu, "Fourier phase based depth-resolved nanoscale nuclear architecture mapping for cancer detection," Methods, Elsevier; 136: 134-151 (2018). [***Invited***]
6. **S. Uttam**, H. V. Pham, J. LaFace, B. Leibowitz, J. Yu , R. E. Brand, D. J. Hartman, and Y. Liu, "Early prediction of cancer progression by depth-resolved nanoscale mapping of nuclear architecture from unstained tissue specimens," Cancer Res.; 75: 4718-4727 (2015).

7. **S. Uttam** and Y. Liu, "*Fourier phase* in Fourier-domain optical coherence tomography," J. Opt. Soc. Am. A; 32: 2286-2306 (2015).
8. D. Hartman, A. Krasinskas, **S. Uttam**, K. Staton, R. K. Bista, S. Rizvi, A. Slivka, R. Brand, and Y. Liu, "Assessment of nuclear nano-morphology marker to improve the detection of malignancy from bile duct biopsies," Am. J. Clin. Pathol; 141(6): 884-91 (2014).
9. Y. Liu, **S. Uttam**, S. Alexandrov, and R. K. Bista, "Investigation of nanoscale structural alterations of cell nucleus as an early sign of cancer," BMC Biophysics; 7:1 (2014). [***Invited***]
10. **S. Uttam**, R. K. Bista, K. Staton, S. Alexandrov, S. Choi, C. Bakkenist, D. Hartman R. Brand, and Y. Liu, "Investigation of depth-resolved nanoscale structural changes in regulated cell proliferation and chromatin decondensation," Biomed. Opt. Express ; 4: 596-613 (2013).
11. **S. Uttam**, S. Alexandrov, R. K. Bista, and Y. Liu, "Tomographic imaging via spectral encoding of spatial frequency," Opt. Express; 21: 7488-7504 (2013).
12. K. E. Fasanella, R. K. Bista, K. Staton, S. Rizvi, **S. Uttam**, C. Zhao, A. Sepulveda, R. E. Brand, K. McGrath, and Y. Liu, "Nuclear nano-architecture markers of gastric cardia and upper squamous esophagus detect esophageal cancer 'field effect'," J. Cancer; 4(8): 626-634 (2013)
13. **S. Uttam**, N. Goodman, and M. Neifeld, "Feature-specific difference imaging," IEEE Trans. Image. Process.; 21(2): 638-652 (2012).
14. S. Alexandrov, **S. Uttam**, R. K. Bista, and Y. Liu, "Spectral encoding of spatial frequency approach for characterization of nanoscale structures," Appl. Phys. Lett., 101 033702 (2012).
15. S. Alexandrov, **S. Uttam**, R. Bista, R Zhao, and Y. Liu, "Real-time quantitative visualization of 3D structural information," Opt. Express; 20: 9203-9214 (2012).
16. R. Bista, **S. Uttam**, D. Hartman, W. Qiu, L. Zhang, R. Brand, and Y. Liu, "Investigation of nuclear morphology of cells as a biomarker for cancer risk assessment using a mouse model," J. Biomed. Opt.; 17(6):066014 (2012).
17. R. Bista, P. Wang, R. Bhargava, **S. Uttam**, R. E. Brand, and Y. Liu, "Nuclear nano-morphology markers of histologically normal cells detect the 'field effect' of breast cancer," Breast Cancer Research and Treatment; 135(1):115-124 (2012).
18. **S. Uttam**, R. Bista, D. Hartman, R. Brand, and Y. Liu, "Correction of stain variations in nuclear refractive index of clinical histology specimens," J. Biomed. Opt.;16: 116013 (2011).
19. S. Alexandrov, **S. Uttam**, R. Bista, and Y. Liu, "Spectral contrast imaging microscopy," Opt. Lett.; 36: 3323-3325 (2011).
20. R. Bista, **S. Uttam**, P. Wang, L. Staton, S. Choi, C. Bakkenist, D. Hartman, R. Brand, and Y. Liu, "Quantification of Nanoscale Nuclear Refractive Index Changes during the Cell Cycle," J. Biomed. Opt. Lett.; 16(7): 070503 (2011).
21. **S. Uttam** and N. Goodman, "Superresolution of Coherent Sources in Real-Beam Data," IEEE Trans on Aerosp. Electron. Sys.; 46(3):1557-1566 (2010).
22. P. Wang, R. Bista, W. Khalbuss, W. Qiu, **S. Uttam**, K. Staton, L. Zhang, T. Brentnall, R. Brand and Y. Liu, "Nanoscale nuclear architecture for cancer diagnosis beyond pathology via spatial-domain low-coherence quantitative phase microscopy," J. Biomed. Opt.; 15(6):066028 (2010).
23. **S. Uttam**, N. Goodman, M. Neifeld, C. Kim, R. John, J. Kim, and D. Brady, "Optically multiplexed imaging with superposition space tracking," Opt. Express; 17:1691-1713, (2009).

Collaborative Acknowledgments in Peer-reviewed Journal Publications

For **performing biostatistics** in:

1. D. Parikh, E. Fouquerel, C. T. Murphy, H. Wang, and P. Opresko, "Telomeres are partly shielded from ultraviolet-induced damage and proficient for nucleotide excision repair of photoproducts," Nat. Comm.; 6:8214 (2015).
2. E. Fouquerel, J. Lormand, A. Bose, T. Lee, G. Kim, J. Li, R. W. Sobol, B. Freudenthal, S. Myong, P. L. Opresko, "Oxidative guanine base damage regulates human telomerase activity," Nat. Struct. Mol. Biol.; 23(12):1092-1100 (2016)

Conferences, Presentations, Talks

1. **S. Uttam** and Y. Liu "Three-dimensional nanoscale nuclear architecture mapping for improved cancer risk stratification," SPIE/OSA European Conferences on Biomedical Optics (ECBO) 2019, 23-27 June 2019, Munich, Germany; Paper 11076-38 (2019). [***Invited***]
2. **S. Uttam**, A.M. Stern, S. A. Furman, F. Pullara, F. Ginty, D. L. Taylor, S. C. Chennubhotla, "Spatial proteomics with hyperplexed fluorescence imaging predicts risk of colorectal cancer recurrence and infers recurrence-specific protein-protein networks," Cancer Res; 79 (13 Supplement): 1642 (2019). [AACR Annual Meeting 2019, March 29-April 3 2019, Atlanta, Georgia.]
3. **S. Uttam**, "Hyperplexed immunofluorescence imaging based on spatial proteomics predicts risk of colorectal cancer recurrence and infers recurrence-specific protein networks," Joint Immunology and Computational and Systems Biology Workshop, Jan 23, 2019, University of Pittsburgh, Pittsburgh, PA, USA (2019).
4. R. C. Burgess and **S. Uttam**, "Modeling the impact of chromatin modifications on the DNA damage response in yeast," Find Your Inner Modeler workshop, Aug 16–17, 2018, University of Illinois at Chicago, Chicago, Illinois, USA (2018). [***Travel award***]
5. **S. Uttam**, F. Pullara, and C. Chennubhotla, "Comparative dynamics – An information theoretic perspective," Biomolecular Machines Conference – Protein Flexibility and Allostery, May 18–21, 2017, Banff, Alberta, Canada (2017).
6. F. Pullara, N. Bouhenni, **S. Uttam**, and C. Chennubhotla, "Integrative strategies for probing energy landscapes and dynamics of IDPs," Workshop on Intrinsically Disordered Proteins, TSRC 2017, July 11–14, 2017; Telluride, Colorado, USA (2017)
7. **S. Uttam**, "Nanoscale nuclear architecture mapping for cancer-risk stratification and prediction," Computational Pathology Lecture Series, April 14, 2017; Computational Pathology Interest Group and Lecture Series, University of Pittsburgh, Pittsburgh, Pennsylvania, USA (2017). [***Invited***]
8. Y. Liu, **S. Uttam**, H. V. Pham, and D. J. Hartman, "Improved cancer risk stratification and diagnosis via quantitative phase microscopy," SPIE Photonics West (BIOS), Jan 28 – Feb 2 2017, San Francisco, USA; Conference: Quantitative Phase Imaging III; Paper 10074-40 (2017). [***Invited***]
9. **S. Uttam**, J. LaFace, J. Y. Tang, J. Al Hashash, D. J. Hartman, R. E. Brand, and Y. Liu, "Multi-dimensional nanoscale nuclear architecture mapping (md-nanoNAM) for prospective prediction of cancer progression in inflammatory bowel disease (IBD) colitis patients," Applied Pathology Informatics, Pathology Informatics Summit 2016, May 23–26, 2016, Pittsburgh, Pennsylvania, USA (2016).
10. **S. Uttam** and Y. Liu, "Theory of Fourier phase within the framework of Fourier-domain optical coherence tomography," SPIE Photonics West (BIOS), Feb 13–18, 2016, San Francisco, CA; Conference: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XX; Paper 9697-99 (2016).
11. **S. Uttam**, H. V. Pham, J. LaFace, D. J. Hartman, and Y. Liu, "Depth-resolved nanoscale nuclear architecture mapping for early prediction of cancer progression," SPIE Photonics West

(BIOS), Feb 13–18, 2016, San Francisco, CA; Conference: Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XX; Paper 9697-79 (2016).

12. **S. Uttam** and Y. Liu, "Eigenmoment-based estimation of correlation length from spatial-frequency profile for structural characterization of continuous random medium," in Biomedical Optics, OSA Technical Digest (Optical Society of America, 2014), paper BS3A.36.
13. H. V. Pham, **S. Uttam**, and Y. Liu, "Multimodal hyperspectral full-field quantitative phase microscopy," in Biomedical Optics, OSA Technical Digest (Optical Society of America, 2014), paper BT3A.7.
14. Z. Li, R. Bhargava, K. Staton, H. Wang, **S. Uttam**, R. Brand, A. Soran, G. Ahrendt, and Y. Liu, "Nuclear Nano-Morphology Markers Predict Breast Cancer Risk in Patients with Atypical Breast Epithelial Hyperplasia," Lab. Invest., Vol. 94, 64A (2014).
15. **S. Uttam**, K. Staton, R. Bista, R. Bhargava, D. Hartman, R. Brand, and Y. Liu, "Analysis of nano-morphology characteristics as a novel marker for cancer risk assessment," UPCI Scientific Retreat, University of Pittsburgh, Pittsburgh, June 2013.
16. S. Alexandrov, **S. Uttam**, R. Bista, K. Staton, and Y. Liu, "Spectral encoding of spatial frequency approach for characterization of 3D structures," SPIE Photonics West (BiOS), San Franscisco, CA, Feb. 2013.
17. Y. Liu, S. Alexandrov, **S. Uttam**, R. Bista, and C. Zhao, "Real-time quantitative structural imaging of label-free objects," SPIE Photonics West (BiOS), San Franscisco, CA, Feb. 2013.
18. **S. Uttam**, S. Alexandrov, R. Bista, and Y. Liu, "Spectral encoding of spatial frequency approach for imaging and characterization of 3D structures," USNC-URSI National Radio Science Meeting (along with IEEE Antennas and Propagation Society), January 2013, Boulder, Colorado.
19. S. Alexandrov, **S. Uttam**, R. Bista, and Y. Liu, "Spectral encoding of spatial frequency approach for quantitative visualization and characterization of 3D structures," in Biomedical Optics, OSA Technical Digest (Optical Society of America, 2012), paper BTu3A.57.
20. **S. Uttam**, S. Alexandrov, R. Bista, and Y. Liu, "Model-based demonstration of spectral tomographic imaging," in Biomedical Optics, OSA Technical Digest (Optical Society of America, 2012), paper BSu3A.61.
21. Y. Liu, S. Alexandrov, **S. Uttam**, and R. Bista, "Probing cell nanoscale structural properties using intrinsic contrast of light scattering," Biophysical Journal, Vol. 102, Issue 3, S1 (2012). [***Invited***]
22. R. Bista, **S. Uttam**, D. Hartman, W. Qiu, J. Yu, L. Zhang, R. Brand, and Y. Liu, "Investigation of nuclear nano-morphology markers as a novel biomarker for cancer risk assessment using a mouse model," Digestive Disease Week 2012, May 19-22, 2012, San Diego, California, USA (Abstract).
23. D. Brokl, D. Lo, W. Khalbuss, P. Wang, R. Bista, **S. Uttam**, Y. Liu, and R. Brand, "Spatial-domain low-coherence quantitative phase microscopy to improve the cytological diagnosis of pancreatic cancer," Gastroenterology - Orlando, 2011; 140(1):S-53. [***Plenary talk***]
24. **S. Uttam**, N. Goodman, and M. Neifeld, "Difference imaging from linear spatial-domain projections," SIAM Conference on Imaging Science, San Diego, CA July 2008.
25. **S. Uttam**, N. Goodman, and M. Neifeld, "Direct reconstruction of difference images from optimal spatial-domain projections," in Proc. SPIE Conference on Optics & Photonics, San Diego, CA, Aug. 2008.
26. **S. Uttam**, N. Goodman, M. Neifeld, D. Brady, J. Kim, and C. Kim, "Optically multiplexed imaging with superposition-space tracking," in Proc. SPIE Conference on Optics & Photonics, San Diego, CA, Aug. 2008.

Teaching

CMPBIO2015/MSCBIO2015: Computational Bioimaging for Spatial Systems Biology (Spring 2019)
Department of Computational and Systems Biology, University of Pittsburgh
My role: Co-instructor

BIOENG1383/2383: Biomedical Optical Microscopy (Spring 2011, 2012, 2014, 2017)
Department of Bioengineering, University of Pittsburgh
(Instructor: Dr. Yang Liu)
My role: Invited lectures on computational imaging and image analysis.

MSCBIO/CMPBIO 2065: Scalable Machine Learning for Big Data Biology (Fall 2016, 2017)
Department of Computational and Systems Biology, University of Pittsburgh
(Co-instructors: Drs. Chakra Chennubhotla and David Koes)
My role: Invited lectures on spectral clustering , sparse coding, compressive sensing, and graphical models.

ECE220: Basic Circuits (Fall 2003, Spring and Fall 2004)
Department of Electrical and Computer Engineering, University of Arizona
(Instructor: Dr. Robin N. Strickland)
My role: Graduate Teaching Assistant; tutorials and lectures five days a week

NATS102: The Universe and Humanity: Origin and Destiny (Spring 2003)
Lunary and Planetary Laboratory, University of Arizona.
(Instructor: Dr. Tom Gehrels)
My role: Graduate Teaching Assistant; tutorials and Questions/Answer sessions.

Industry collaborations

Company: Cernostics, Pittsburgh, PA
Project: Incorporating spatial heterogeneity analytics to impact the ability to predict the progression of Barrett's Esophagus
Duration: May 2017 through January 2019

Patents

Patent title: Spatial-domain low-coherence quantitative phase microscopy
Patent No.: 10156479; Date of Patent: December 18, 2018; Filing Date: December 5, 2014

Patent title: Depth-resolved spatial-domain low-coherence quantitative phase microscopy for unstained tissue and cells
Patent No.: 9983399; Date of Patent: May 29, 2018; Filing Date: February 26, 2016

Patent application
Title: System and method for predicting the risk of cancer recurrence from spatial multi-parameter cellular and sub-cellular imaging data for tumors by identifying emergent spatial domain networks associated with recurrence
Application No.: PCT/US2019/033662
Filing Date: May 23, 2019

Professional memberships and Service

Member,

Institute of Electrical and Electronics Engineers (IEEE),
Optical Society of America (OSA),
SPIE,
Society for Industrial and Applied Mathematics (SIAM),
Association for Pathology Informatics (API)

Grant Reviewer,

- Biomedical Modeling Pilot Awards
  Institution: Clinical and Translational Science Institute (CTSI), University of Pittsburgh, PA.

Journal Reviewer,

1. Nature publishing group:
    - Nature Communications;
      Scientific Reports
2. American Association for Cancer Research:
    - Cancer Research;
      Cancer Prevention Research;
      Clinical Cancer Research;
      Cancer Epidemiology, Biomarkers & Prevention
3. Elsevier:
    - Computers in Biology and Medicine;
      Methods
4. Institute of Electrical and Electronics Engineers (IEEE):
    - IEEE Access;
      Transactions on Aerospace and Electronic Systems;
      Transactions on Geoscience and Remote Sensing;
      Journal of Selected Topics in Applied Earth Observations and Remote sensing;
      IEEE International Symposium on Circuits and Systems (ISCAS, 2013)
5. Optical Society of America (OSA):
    - Journal of Optical Society of America A;
      Optics Express;
      Biomedical Optics Express;
      Optics Letters;
      Applied Optics;
      Optical Materials Express
6. SPIE:
    - Journal of Biomedical Optics
7. BioMed Central:
    - Diagnostic Pathology
8. Public Library of Science (PLOS):
    - PLOS ONE

Thesis Committee Member,

Student: Akash Parvatikar, School of Computing and Information, University of Pittsburgh
MS Thesis title: Anharmonic Conformational Analysis for Biomolecular Simulation
MS Thesis defense: April 13, 2018.

Student supervision

Dan Spagnalo
PhD student: Joint CMU-Pitt Ph.D. Program in Computational Biology
Graduation: May 2018
Topic: Quantifying Spatial Intra-Tumor Heterogeneity from Multiplexed Fluorescence Images
My role: Mentoring and supervising Dan on the second half of his dissertation. The focus was on quantifying the spatial statistics of features of multiplexed immunofluorescence biomarkers and how they define spatial heterogeneity, and their resulting ability to predict patient outcomes.

Nassima Bouhenni (TecBio 2017; a 10-week National Science Foundation funded undergraduate summer research program at University of Pittsburgh)
Undergraduate student: Mathematical Biology, Dietrich School of Arts & Sciences, U. of Pittsburgh
Topic: Probabilistic modeling of structure and dynamics of intrinsically disordered proteins.
My role: Advisor

Luong Nguyen
PhD student: Joint CMU-Pitt Ph.D. Program in Computational Biology
Graduation: August 2017
Topic: Computational Pathology for Quantifying Spatial Heterogeneity in Transmitted Light and Immunofluorescence Digital Images Obtained from Tissue Sections of Solid Tumors
My role: Mentoring and supervising Loung on the last chapter of her dissertation. The chapter proposed computational pathology tools for immunofluorescence imaging that relate correlation features associated with protein expressions with patient outcomes such as time to cancer recurrence.

Stephen Kita (TecBio 2013)
Undergraduate student: Department of Bioengineering, University of Pittsburgh
Topic: Feature-based registration of histology images
My role: Mentor

Assistantships and Internships

Graduate Research Assistant, (January 2005 – September 2010)
Sensor and Array Processing Laboratory,
Electrical and Computer Engineering, University of Arizona.
Lab Director: Dr. Nathan A. Goodman

Graduate Teaching and Research Assistant, (August 2003–December 2004)
Teaching: ECE220 Basic Circuits,
Digital Image Processing Laboratory,
Electrical and Computer Engineering, University of Arizona.
Lab Director and Course Instructor: Dr. Robin N. Strickland

Research Intern, Image Analysis and Photometry, (May 2003–August 2003)
Steward Observatory, University of Arizona.
Lab Director: Dr. George Rieke

Graduate Teaching Assistant, (January 2003–May 2003)
NATS102 The Universe and Humanity: Origin and Destiny,
Lunar and Planetary Laboratory, University of Arizona.
Course Instructor: Dr. Tom Gehrels

Undergraduate Summer Intern, (May 2001–August 2001)
Center for VLSI Design and Prototyping,
Department of Electronics and Information Technology,
Govt. of India, New Delhi INDIA.
Lab Director: Dr. Debashis Dutta

Grader,
ECE435 Introduction to Digital Communication Systems (senior level undergraduate course),
ECE538 Radar Signal Processing (graduate level course)

Computer Skills

Languages: C, C++, Python, Java
Computational languages: Matlab, Mathematica
Statistical packages: R
Operating systems: Linux, Windows