

## CURRICULUM VITAE

Department of Computer Engineering & Sciences  
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### EDUCATION

Ph.D. Computer Science	May, 1994	Center for Advanced Computer Studies University of Louisiana at Lafayette (ULL)
Ph.D. Physics	May, 1984	Indian Institute of Technology (IIT) Kharagpur, India
M.Sc. Physics	May, 1977	IIT, Kharagpur, India

### PROFESSIONAL EXPERIENCE

#### Academic Positions

2009 – present	Professor, Department of Computer Engineering & Sciences Florida Institute of Technology (FIT), Melbourne, Florida
2001 - 2009	Associate Professor, Department of Computer Sciences, FIT
1999-2001	Associate Professor (Tenured), Dept. of Computer Science, Jackson State University (JSU), Jackson, Mississippi
1994-1999	Assistant Professor (Tenure track), Dept. of Comp. Science, JSU

#### Visiting Positions

2019	Visiting Professor in Mathematics, Stanford University, California
2009– present	Affiliated Scientist, Dept. Radiotracer Development and Imaging Technology (DRIT), Lawrence Berkeley National Lab (LBNL), Berkeley, California
2000-2001	Invited Professor, Univ. of Paris-South, CNRS/LIMSI Lab, France

#### Short Term Research Visits (Sample)

2008	1. Indian Institute of Technology, Mumbai, 2. Tata Institute of Fundamental Research, Mumbai
2007	Oxford University, Constraint Reasoning Lab, UK
2002	1. Vienna Technical University, Austria 2. Asian Institute of Technology, Bangkok, Thailand
2001	Linkoping University, AI Lab, Sweden

**Google Scholar:** *Listed publications: 107, Citation: 409, h-index: 10, i10-index: 10*  
<https://scholar.google.com/citations?hl=en&user=NhIPH-8AAAAJ>

**ResearchGate:** *RG Score: 21.34, h-index: 11/9, 72.5% percentile*  
*Research Interest: 244.1, Citations: 437*

### AWARD

Outstanding faculty member (HEADWAE, 2000): An award for academic excellence in research and teaching, from the State Legislature of Mississippi (awarded February 20, 2001)

### SELECTED FUNDED PROJECTS

- National Institute of Health: "Energy-Independent Single Photon Molecular Imaging Technology," Subcontract from UCSF, (\$63,584), 2013-2018.
- National Institute of Health: "Molecular Imaging of Cardiac Hypertrophy using MicroPET and Pinhole SPECT Project," as Subcontract from LBNL, (\$46,042), 2012-2013.
- National Institute of Health: "Designing and Maintaining Nuclear Medicine Database," as Subcontract from LBNL, (\$26,648), 2010-2012.
- National Science Foundation (NSF, IIS-0732566): "*Creativity in Physics: SGER*," 2007-2009 (\$99,331).
- Department of Homeland Security (DNDO): "*Muon Radiography for Nuclear Contraband Detection*," 2007-2010, as Co-PI (PI: Dr. Marcus Hohlman, Department of Physics and Space Sciences, FIT), awarded amount: \$228,705, 2007-08, and \$571,453 for 2008-09.
- National Science Foundation (NSF, IIS-0296042): "*CAREER award: Temporal/Multi-dimensional Reasoning with Uncertainty*," 1998-2002 (~\$300,000).

- NASA Glenn (formerly, Lewis) Research Center: "System Definition and Object Oriented Programming for a Rocket Engine Numerical Simulation," NCC3-437, 10/23/1995 – 12/31/1999, \$284,267 (PI from 1997). "Intelligent Interface to the Numerical Simulators (IINS) of Aerospace Transportation Engines," NCC3-2277, 7/22/1999 – 8/1/2001, \$35,032.

### SELECTED PUBLICATIONS

- Mitra D. (2008) "Three generations of research in computational creativity and beyond," in *Association for Advancement of Artificial Intelligence Tech Report on Creative Intelligent Systems*. Ventura D, Maher ML, and Colton S (Eds.)
- Renz J., Mitra D. (2004) Qualitative Direction Calculi with Arbitrary Granularity. In: Zhang C., W. Guesgen H., Yeap WK. (eds) *PRICAI: Trends in Artificial Intelligence, Lecture Notes in Computer Science*, vol 3157. Springer, Berlin, Heidelberg.
- Mitra D, and Ligozat G. (2002) "Spatial-reasoning for Agents in Multiple Dimensions," Debasis and Gerard Ligozat, *Jnl. of Universal Computer Science*, 8(8): 774-791.
- Guesgen HW, and Mitra D. (1999) "A multiple-platform decentralized route finding system." *Springer Lecture Notes in Computer Science, Series: Multiple Approaches to Intelligent Systems*, 1611:707-713. Imam IF, Kodratoff Y, El-Dessouki A, and Ali M. (Eds.): ISBN 3-540-66076-3.
- Mitra D, and Pal N. (1999) "Complexity studies of a temporal constraint propagation algorithm: A statistical analyses," *Jnl. of Experimental and Theoretical Artificial Intelligence*, 11:155-183.
- Mitra D. (1998) "Cluster Forming Interval Sub-algebras," *CONSTRAINT journal*, 3:179-189.
- Basu D, and Mitra D. (1981) "The Lorentz group in oscillator realization III - the group  $SO(3,1)$ ," *Jnl. of Mathematical Physics*, 22(5): 946-953.

### SELECTED GRADUATE STUDENT MENTORING ACTIVITIES

- Brad Nelson, Ph.D. student at Dept. of Mathematics and Inst. of Computational Math. and Engineering, Stanford University, CA. Collaboration topic: *Topological Analysis of Textures in Medical Images*.
- Anjan Dwarkanath, Ph.D. student at Dept. of Mathematics and Inst. of Computational Math. and Engineering, Stanford University, CA. Collaboration topic: *Use of Topological Analysis in Deep Learning*.
- Haoran Chang, Ph.D. (to graduate in December 2020) Dissertation Topic: *Deep Learning Based SPECT Tomographic Reconstruction*.
- Gengbo Liu, Ph.D. (to graduate in May 2019) Dissertation Topic: *Cancer Prognosis with Machine Learning*.
- Hui Pan, Ph.D. (August 2015) Dissertation Topic: *Parallelization of Iterative Reconstruction Algorithms in Medical Imaging*. (Tencent Corp., China)
- Mahmoud Abdalah, Ph.D. (December 2014) Dissertation Topic: *Novel Optimization Algorithm for Dynamic Imaging in SPECT*. (Staff Scientist at Moffitt Cancer Center, Tampa, Florida.)
- Stephen Johnson, Ph.D. (December 2014) Dissertation Topic: *Statistical Analysis of Protein Structure Comparison Algorithms and Metrics*, currently a Computer Science Faculty Member at the Eastern Florida State College.
- Florent Launay, Ph.D. (un-finished, joined Microsoft in 2007) Dissertation Topic: *Detecting Inconsistent Sub-network in a Temporal Interval Constraint Network*. (Software engineer, Microsoft, Seattle.)
- Bo Li, MS (May 2015) Thesis Topic: *4D Segmentation in Sparse Domain using Wavelet Basis Functions*.
- Shi Chen, MS (May 2015) Thesis Topic: *Comparison of Primal-Dual algorithm with Some Iterative Reconstruction Algorithms in Medical Imaging*.
- Antall Fernandes, MS (December 2011) Thesis Topic: *REMI Database: A Data Management System for Nuclear Medicine Studies*.
- Daniel Eiland, MS (May 2013) Thesis Topic: *SinoCor: A Tool for Motion Correction in Cardiac SPECT*.
- Richard Hoch, MS (May 2011) Thesis Topic: *Advances in Cosmic Ray Muon Tomography Reconstruction Algorithms*. (Software engineer, General Dynamics, Florida.)
- Gandhali Samant, MS (May 2006) Thesis Topic: *Correlogram Method for Comparing Bio-Sequences*. (Engineering manager, Microsoft, Mumbai, India.)

- Keith Ledig, MS (May 2006) Thesis Topic: *Protein Folding Secondary Structure Prediction: Homology and Partitioning*.
- Sung-Hoon Park, MS (December 2006) Thesis Topic: *Measurement Techniques for Comparing Fixed Length DNA Sequences*.
- Michael Smith, MS (December 2003) Thesis Topic: *Digital Signal Processing Techniques In The Prediction of Protein Secondary Structures*.

### SELECTED UNDERGRADUATE RESEARCH

- Day K., from Computer Science (CS) and Physics. *A Volume Clearing Algorithm for Muon Tomography, Conf. Record of the IEEE Nuclear Science Symposium, 2014*. (Software engineer, Google Corp., California.)
- Heath C, and Al-Ameen J., from CS, other students from Electrical Engineering and Biomedical Engineering (BME). Senior Design Project: *ASPIS: A smart-phone based device for detecting brain seizure from EEG, 2017-18*.
- Cisek D., and four others from BME, and Hoog D., from CS. Senior Design Project: *EEG-controlled wheelchair, ongoing 2018-19*.

### TEACHING

<b>Courses Taught:</b>	Artificial Intelligence Design and Analysis of Algorithms Formal Languages and Automata Theory Discrete Mathematics Databases
<b>Courses Developed:</b>	Temporal Databases Constraint-based Reasoning Computational Molecular Biology Pattern Recognition in Medical Imaging Scientific Computation
<b>Courses Under Development:</b>	Topological Data Analysis Quantum Computing Computational Physics

### ADDITIONAL SCHOLASTIC ACTIVITIES

- Online Free Text (2019): “C++ Lecture Notes”, [cs.fit.edu/~dmitra/Cplus/CplusplusNotes.pdf](http://cs.fit.edu/~dmitra/Cplus/CplusplusNotes.pdf).
- Online Free Text (2016): “Algorithmics: A Text on Algorithms and Analysis”, [cs.fit.edu/~dmitra/Algorithms/Algorithmics.pdf](http://cs.fit.edu/~dmitra/Algorithms/Algorithmics.pdf).

### ADDITIONAL PROFESSIONAL ACTIVITIES

#### Organizer:

*General Chair*, (with Dr. Philip K. Chan, FIT), The Nineteenth FLAIRS conference (originally Florida AI Research Society), 2006

*Co-organizer*: Association for Advancement of Artificial Intelligence Spring Symposium: *Foundations and Applications of Spatio-temporal Reasoning (FASTR)*, Stanford, 2003

#### Reviewing Activities (Sample):

Applied Intelligence Journal, review-board member (Springer)

Machine Vision and Applications journal (Springer)

Journal of AI Research (Open access peer-reviewed journal)

IEEE Transactions on Nuclear Science

Journal of Molecular Biology

Grant proposals, as a panel-member, the NSF

Grant proposals, as a panel-member, the NASA

#### Conference Program Committees (Sample):

Florida AI Research Symposium (FLAIRS)

TIME Conference

International Conference on Industrial Applications of AI (IEA/AIE)

#### Academic Committee Activities (Sample):

*FIT*: University Faculty Promotions Committee, Computer Science (CS) Graduate Comprehensive Exam Committee, and College of Engineering’s Research Council.

*JSU*: CS graduate committee, CS undergraduate curriculum committee, School of Engineering's Associate Dean Recruitment committee, Computer Engineering Department's faculty recruitment committee.

**Outreach Activities:**

*Judge: Science Fairs* (1998-2004), Jackson, Mississippi; Melbourne, Florida

*Event organizer* (1996-99): Mississippi Science Olympiads

**MEMBERSHIPS**

International society for optics and photonics (SPIE)

Association of Computing Machinery (ACM)

IEEE, Computer Society

Association for Advancement of Artificial Intelligence (AAAI)

Phi Kappa Phi Honor Society

**REFERENCES**

*Will be provided upon request*

## RESEARCH SUMMARY

### ONGOING RESEARCH

- *Breast cancer prognosis with Deep Learning over medical images.* (With Gengbo Liu, ABD; National Institute of Health, Subcontract from UCSF.) Deep learning with artificial neural networks is making a strong impact in radiology. Apparently medical images, routinely being studied by radiologists over decades, contain more information than originally thought of. Our project is showing that hormonal conditions, which are typically probed with invasive biopsy procedures from breast cancer tissues, may be predicted from images with a high degree of certainty non-invasively. Knowledge of hormonal status is an important component in treatment pathway of breast cancer and some other cancers.
- *Deep Learning based CT, SPECT and PET image reconstruction, solving Inverse problems with 3D Generative Adversarial Deep learning neural network.* (With Haoran Chang, Ph.D. student.) Computed Tomography (CT) with X-ray absorption, Single Photon Emission Computed Tomography (SPECT) with Gamma-emitting tracer compound injected to a patient, and Positron Emission Tomography (PET) with positron emitting tracer (that decays to pair of Gamma photons) are three primary medical imaging modalities. A fundamental inverse problem in medical imaging is to reconstruct the 3D (or 4D) views of the body from 2D views of detector cameras. The advent of the deep learning technique in artificial intelligence is likely to revolutionize this challenging mathematical problem of tomographic image reconstruction.
- *Topological Data Analysis (TDA) on time-series data of 4D contrast enhanced ultrasound data (CEUS).* Target Agency: NIH. (Collaboration with Rubin lab at Stanford Medical School). During my Sabbatical leave (Fall 2018) at Stanford I worked closely with a group (Dr. Daniel Rubin) in the Medical School and a group in Mathematics department (Prof. Gunnar Carlsson). A project is undergoing to utilize TDA techniques over this data for a better understanding of 4D cancer images.

### PROJECTS UNDER DEVELOPMENT

- *Spatio-temporal calculus (STC) in Topological Data Analysis (TDA).* Target Agency: NSF. (A collaboration with Prof. Gunnar Carlsson, Mathematics dept. and his student Brad Nelson from the Inst. of Comp. Math and Eng. (ICME) at Stanford.)  
My computer science dissertation and subsequent works were on reasoning with space and time (within AI), supported by the NSF with a CAREER award (1998-2004). During my recent study on TDA at Stanford (during the Sabbatical leave, Fall 2018) I noticed the possibility of applying some spatio-temporal calculi in TDA. Brad and I are trying to apply this in texture analyses of medical images.
- *Deep Learning in Combinatorial Problems.* Target Agency: NSF. (A collaboration with Prof. Gunnar Carlsson, Mathematics dept. and his student Anjan Dwarkanath from the Inst. of Comp. Math and Eng. (ICME) at Stanford.)  
Deep neural networks are at the cutting edge of artificial intelligence. However, it is not very well known how do these networks actually learn or what do they model. We are studying how deep learning “learns” from data. Basic hypothesis of our study is that topological relationships in data affect learning quality and speed.
- *Muon tomography for Bone density measurement.* Target Agency: NIH. (A collaboration with Prof. Marcus Hohlmán, Physics, FIT.)  
Cosmic ray generated muon particle-shower is generated in upper atmosphere continuously. Muons are stochastically scattered from nuclei of atoms depending on latter's atomic numbers. This radiation free imaging modality is an ideal tool for bone mineral density measurement that is important in osteoporosis diagnosis. We have utilized this technology for homeland security before. We are exploring the possibility of using it for medical purpose.
- *Quantum simulation of CT/SPECT/PET scattering.* Target Agency: NIH / NSF-Quantum Computing.  
Gamma scattering in SPECT and PET imaging is considered as a noise that affects image quality in emission tomography. However, scattering from surrounding tissues may contain medical information. A project is being contemplated in this direction that will involve quantum level simulation of photon scattering from bio-molecules. This will extend our current expertise at FIT and at UCSF on physics simulation with GEANT4 simulation package, and also our efforts to develop expertise in quantum chemistry and biology at FIT. I have interests in computational molecular biology (please see publications and students' lists).

- *TDA on cosmology data. Target Agency: DOE / NASA.* (Seeking collaboration at FIT, Stanford and/or LBNL).  
Understanding physics at cosmic level involves studying the structure of cosmos, like voids or filaments and their inter-connections. This makes application of topological tools very natural. With expertise in image understanding with medical data we are in a position to conduct such studies. My Sabbatical host Prof. Carlsson is willing to help me set up a project in this direction and I have communicated with the Computational Cosmology group at LBNL in the past. My own graduate studies on mathematical physics also will be useful in developing this project.
- *Temporal constraint solver for timed-automata. Proposal submitted (2018): NSF.* (Collaborator: Dr. Siddhartha Bhattacharyya, FIT)  
Formal verification method of logically designed systems, like aircraft control or medical devices, is a well-established area within computer science. These types of model-checking systems use timed-automata as their underlying engines. Along with two other faculty members in our department, Drs. S. Bhattacharyya and R. Stansifer, I am trying to develop a project in significantly enhancing such model-checking systems with temporal constraint reasoning (within AI) that I have worked on before with prior NSF funding. Currently, I am also trying to develop a collaboration with a faculty member at Univ. of Southern California, Dr. T.S. Kumar, on a related problem in temporal constraint reasoning.

PAST PROJECTS	TOPICS INVOLVED	OUTPUT
Clebsch-Gordon coefficients computation of SO(2,1) and SO(3,1)	Lie Groups, Integral Transform, Special functions, Group representation, Oscillator representation	PhD dissertation, Two journal papers, one unpublished work
Seismic Data Processing	Common Depth Point stacking, Applied Predictive deconvolution, Digital filtering, Fortran Programming, Script-based seismic data processing	Onboard quality control of seismic data acquisition, developed a navigation software for triangulation to find ship's location that was used by the company
Exploration Geology	Petroleum Geology, Seismic data interpretation (not 3D analyses), Structural and stratigraphic exploration of oil and gas	Proposed exploratory oil and gas wells
Spatio-temporal Qualitative data Representation and Reasoning (Artificial Intelligence)	Relational Algebra, Coding in C++98, Statistical analyses of computational experimental data, Phase transition in computational problems	Numerous conference and journal papers, PhD Dissertation ( <i>NSF funded</i> )
Rocket Engine Numerical Simulator (wrapper for Fortran code library, as used in Numerical Data processing)	Software library code analysis, Software re-design	Technical reports, two conference papers ( <i>NASA funded</i> )
Muon Tomography	C++98 coding, Muon scattering physics, Tomographic reconstruction, Density-based clustering	Numerous papers in conferences and journals, POClust algorithm, and Volume clearing algorithm ( <i>DHS/DNDO funded</i> )
Creativity in Physics	Pre-Machine Learning era algorithms for scientific data analysis	Coined the word "Computational Creativity," a Tech report, historical analysis of computational creativity in science and their implications ( <i>NSF funded</i> )
Data management for medical imaging	Ruby on Rails, Large 3-tier database development, file management	Conference papers ( <i>NIH/LBNL funded</i> )
Dynamic SPECT image reconstruction	Inverse problem solving, Factor analysis, Statistical iterative image	Numerous conference and journal papers, SIFADS code

(NIH proposal line from FIT, Tried as research proposals to Google and Amazon Research)	reconstruction	(Spline initialized factor analysis in dynamic structures, yet-to-be licensed), one PhD student's dissertation, one Patent disclosure <i>(NIH/LBNL funded)</i>
Dynamic PET image processing (developing NIH proposal line from Stanford)	Alzheimer's disease studies	One journal paper
Motion correction for SPECT imaging (SinoCor – Sinogram Correction)	Java coding	Conference papers, Software license at LBNL; One Master's thesis
GPU-based parallelization	Parallel processing, CUDA	Conference papers, one journal paper, one PhD student's dissertation <i>(NIH/UCSF funded)</i>

## TEACHING STATEMENT

Students, currently have the highest level of interests in deeper understanding of computer science that I have ever seen before. Empowered by search engines and sites like Wikipedia, democratization of knowledge is creating a revolution, when it comes to teaching and learning. I am deliberately taking advantage of this and have revised my teaching paradigm. Students sit with open computers connected to the Internet via WiFi in the class. All a teacher has to do during a lecture is to provide the needed key word or url address and wait for a few moments for students to browse. Yes, not all students do take advantage of it and traditional lecture continues. However, these interludes significantly enhances the breadth and depth of knowledge for most of the students. Also, those who are not online-savvy (I am not), may always be encouraged (or coaxed with grading mechanisms) to browse and learn offline from the world wide knowledge on the web. My class projects and assignments have gone to the point that becomes difficult for me to even believe. For example, in my artificial intelligence class I routinely ask students (in group projects) to learn and implement cutting edge technology that I myself have no resources to fully grasp. And, always students (almost all) amaze me at the end of the semester by completing the requirements of projects, and sometimes going beyond. For a specific example, I asked a student group to train a deep learning model for detecting if a path exists in a maze. This involves significant number of maze generation for training and validation, not only with mazes that have path connecting given starting and ending locations, but also those without any path. Students found tools for maze generation, path detection, and convolutional neural networks to solve the problem that I believed was beyond the capability deep learning. Many of such innovative projects are publication worthy, but neither students nor I always have time to do all the additional works needed for a traditional article for a peer review. I often put students' works online for any interested researcher. I do not know how long this enthusiasm within students will survive, but it is an exciting time to teach computer science.