

DEEPAK ROY CHITTAJALLU

Email: cdeepakroy@gmail.com

Homepage: <https://www.linkedin.com/in/cdeepakroy>

EDUCATION

Postdoctoral Training, Computational Cell Biology

2012 –2014

Harvard University, Cambridge, MA, USA

Advisor: Prof. Gaudenz Danuser

Research Topic: Design and development of computer vision and machine learning algorithms to facilitate large-scale studies of the effects of cancer drugs at a cellular level using 3D intravital microscopy data.

Ph.D., Computer Science

2007 –2010

University of Houston, Houston, Texas, USA

Advisor: Prof. Ioannis A. Kakadiaris

Dissertation: Random Field Models for the Segmentation of Medical Images: Application to Coronary Artery Calcium Detection in Non-contrast CT data

Honors: Recipient of the “Best PhD Award”, Dept. of Computer Science, University of Houston, 2010.

M.Sc., Computer Science

2004 –2007

University of Houston, Houston, Texas, USA

Advisor: Prof. Ioannis A. Kakadiaris

Thesis: Computational Tools for Computer-Aided Breast Reconstructive Surgery

B.Tech., Computer Science and Information Technology

2000 – 2004

Jawaharlal Nehru Technological University, Hyderabad, India

Advisor: Prof. Kumar Eswaran

Thesis: Vigilcam – A Video Surveillance System

First Class with
Distinction

RESEARCH/WORK EXPERIENCE

• Principal R&D Engineer

2018 - present

Staff R&D Engineer

2017 - 2018

Senior R&D Engineer

2016 - 2017

R&D Engineer

2014 - 2016

Kitware, Carrboro, NC, USA

Research Areas: Biomedical Image Analysis, Computer Vision and Machine Learning

Environment: C++, Python, ITK, TubeTK, Scikit-learn, Caffe, Linux

Contributions:

1. Co-direct the development of HistomicsTK – an open-source python toolkit for the analysis of whole-slide histopathology images in association and clinical and genomic data for cancer classification and prognostics.
2. Developed a machine learning method based on vectorized persistent homology representations for cancer diagnosis and grading in histopathology images.

3. Developed an integrated machine learning approach for facilitating content-based retrieval of video segments from minimally invasive surgery videos using deep convolutional video descriptors and iterative query refinement.
4. Co-directed the development of a web-based platform for facilitating continuous chronic disease surveillance on social networking sites such as Twitter and Instagram using computer vision and machine learning.
5. Developed machine learning pipeline for identifying public Instagram posts involving alcohol consumption and recover the demographic information (e.g. gender, age) of the associated users using state-of-the-art deep learning models.
6. Developed an innovative set of methods that exploit the periodicity of cardiac ultrasound videos for instantaneous cardio-respiratory phase estimation, gating, and temporal super-resolution.
7. Co-developed a hybrid deep learning based method for the segmentation of vessels in noisy 3D Ultrasound Angiography images.
8. Developed a machine learning method, based on quantitative measures of vessel tortuosity, to detect tumors in Ultrasound Angiography images of genetically engineered mice.
9. Developed a minimum spanning tree based algorithm for automatic or semi-automatic computation of connectivity between a disjoint set of tubes/vessels obtained from a vessel segmentation algorithm.

- **Postdoctoral Research Fellow**

2012 – 2014

Laboratory of Computational Cell Biology,
Harvard Medical School, Boston, MA, USA
Supervisor: Prof. Gaudenz Danuser

Research Area: Biological Image Analysis and Machine Learning

Research Topic: Design and development of computer vision and machine learning algorithms to facilitate large-scale studies of the effects of cancer drugs at a cellular level using 3D intravital fluorescence microscopy data.

Environment: MATLAB, C++, ITK, WEKA, Imaris, Windows, Linux

Contributions:

1. Developed a method that couples marker-controlled watersheds with a hierarchical learning-based region merging algorithm for the segmentation of hundreds of nuclei from 3D Intravital fluorescence microscopy data.
2. Developed a supervised hierarchical classification scheme for the automatic identification of the cell cycle state of each cell in 3D Intravital fluorescence microscopy data.
3. Developed a learning-based method for quantifying the extent of DNA damage of each individual cell in 3D intravital fluorescence microscopy data.
4. Developed a user-friendly GUI front end that enables a biologist to run the underlying computational framework on any dataset and view the results.
5. Developed a set of software tools to procure ground truth for the validation of underlying algorithms and for generating training data for the algorithmic components based on machine learning.

- **Research Assistant**

2007 – 2011

Computational Biomedicine Lab, Department of Computer Science
University of Houston, Houston, TX, USA
Advisor: Prof. Ioannis A. Kakadiaris

Research Area: Medical Image Analysis and Machine Learning

Research Topic: Design and development of computational methods for the detection and localization of coronary artery calcium deposits in non-contrast CT data for devising a new coronary artery calcium score based on image derived features.

Environment: OpenGL, VTK, ITK, LIBSVM, QT, MATLAB, C++, MS Windows, Linux

Contributions:

1. Developed an explicit shape-constrained MRF-based contour evolution method for image segmentation
2. Developed a Shape-driven MRF Model for the segmentation of organs in medical images.
3. Developed Fuzzy-Cuts – A knowledge-driven graph-based method for medical image segmentation
4. Co-developed a graph-based method for the automatic segmentation of diaphragm in non-contrast CT data.
5. Developed a graph-based method for the automatic delineation of the inner thoracic region in non-contrast CT data.
6. Co-developed a learning-based method for the estimation of coronary artery zones in non-contrast CT data.
7. Co-developed a supervised hierarchical classification scheme for the detection of coronary calcifications in non-contrast CT data
8. Developed the initial set of image-derived features for the development of a new coronary artery calcium score with particular emphasis on leveraging the previously unexplored fact that the location of the calcium deposits within the coronary artery is an important factor in determining its contribution to cardiovascular risk.
9. Supervised a new Ph.D. student and helped him get started on the topic.

- **Research Assistant**

2004 – 2007

Computational Biomedicine Lab, Department of Computer Science

University of Houston, Houston, TX, USA

Advisor: Prof. Ioannis A. Kakadiaris

Research Area: Computer Vision and Computer Graphics

Research Topic: Computer-Aided Breast Reconstructive Surgery

Environment: OpenGL, VTK, QT, C++, MS Windows, MySQL, ABAQUS, Rapid Forms.

Contributions:

1. Developed methods for automatic and semi-automatic estimation of breast volume from a 3D surface scan of the patient's torso.
2. Co-developed a novel geometric model that captures the overall shape of the breast including its key shape variations. The model is accompanied with a physics-based deformable model framework that fits the breast shape model to real data.
3. Developed the UH-CARES software for computer-aided breast reconstructive surgery that includes three modules: (i) Automatic and semi-automatic non-invasive breast volume estimation; (ii) Graphical environment that allows the surgeon to interactively create a female breast model using a novel physics-based parametric deformable model; (iii) Patient database management.
4. Conducted simulation studies for post-mastectomy breast reconstructive surgery using ABAQUS.

- **Summer Intern**

04/2004 – 07/2004

Altech Imaging and Computing, Hyderabad, India,

Supervisor: Prof. Kumar Eswaran.

Research Area: Computer Vision, Video Surveillance

Environment: Microsoft VC++ 6.0, TWAIN, Video for Windows, MS Windows

Work summary:

- The project involved the development of an autonomous security system that continuously monitors the activity captured by surveillance cameras and reports concerned personnel of any suspicious activity. I was in charge of developing two modules: (i) Motion detection and activity perception; and (ii) Video capture and playback.

THESES

- **Ph.D. Random Field Models for the Segmentation of Medical Images: Application to Coronary Artery Calcium Detection in Non-contrast CT Data, 2010**
Department of Computer Science, University of Houston, Texas, USA
Advisor: Prof. Ioannis A. Kakadiaris
- **M.Sc., Computational Tools for Computer-Aided Breast Reconstructive Surgery, 2007**
Department of Computer Science, University of Houston, Texas, USA
Advisor: Prof. Ioannis A. Kakadiaris
- **B.Tech., Vigilcam Video Surveillance System, 2004**
Department of Computer Science and Information Technology
Jawaharlal Nehru Technological University, Hyderabad, India
Advisor: Prof. Kumar Eswaran

REFEREED JOURNAL PUBLICATIONS

1. **D.R. Chittajallu**, M. McCormick, S. Gerber, T.J. Czernuszewicz, R. Gessner, M.S. Willis, M. Niethammer, R. Kwitt, and S. Aylward, "Image-based methods for phase estimation, gating and temporal super-resolution of cardiac ultrasound", IEEE Transactions on Biomedical Engineering (TBME), 2018 (In Press).
2. D.A. Gutman, M. Khalilia, S. Lee, M. Nalisnik, Z. Mullen, J. Beezley, **D.R. Chittajallu**, D. Manthey, and L.A.D. Cooper. "The Digital Slide Archive: A Software Platform for Management, Integration, and Analysis of Histology for Cancer Research." Cancer Research 77 (21):e75–78, 2018.
3. **D.R. Chittajallu**, S. Florian, R. Kohler, R. Weissleder, T. Mitchison, and G. Danuser, "In vivo cell cycle profiling in xenograft tumors using quantitative intravital microscopy," Nature Methods, 12(6): 577-585, 2015.
4. **D.R. Chittajallu**, N. Paragios, and I.A. Kakadiaris, "An explicit shape-constrained MRF-based contour evolution method for 2D Medical Image Segmentation," IEEE Journal of Biomedical and Health Informatics (formerly IEEE TITB), 18(1):120-129, April, 2013.
5. G. Brunner, **D.R. Chittajallu**, U. Kurkure, and I. A. Kakadiaris, "Toward the automatic detection of coronary artery calcification in non-contrast Computed Tomography data," International Journal of Cardiovascular Imaging (IJCI), 26(7):829-38, Oct, 2010.
6. U. Kurkure, **D.R. Chittajallu**, G. Brunner, Y.L. Hai, and I. A. Kakadiaris, "A supervised classification-based method for coronary calcium detection in non-contrast CT," International Journal of Cardiovascular Imaging (IJCI), 26(7): 817-28, Oct, 2010.

7. D. Chen, **D.R. Chittajallu**, G. Passalis, and I.A. Kakadiaris, "Computational tools for quantitative breast morphometry based on 3D scans," *Annals of Biomedical Engineering (ABME)*, 38(5):1703-18, May 2010.

REFEREED CONFERENCE PUBLICATIONS

1. **D.R. Chittajallu**, N. Siekierski, S. Lee, S. Gerber, J. Beezely, D. Manthey, D. Gutman, and L. Cooper, "Vectorized persistent homology representations for characterizing glandular architecture in histology images", *International Symposium on Biomedical Imaging (ISBI)*, 2018.
2. H. Greer, S. Gerber, M. Niethammer, R. Kwitt, M. McCormick, **D.R. Chittajallu**, N. Siekierski, M. Oetgen, K. Cleary, and S. Aylward, "Scoliosis Screening and Monitoring Using Self Contained Ultrasound and Neural Networks", *International Symposium on Biomedical Imaging (ISBI)*, 2018.
3. H. Shah, P. Hernandez, F. Budin, **D.R. Chittajallu**, J.B. Vimort, R. Walter, A. Mol, A. Khan, and B. Paniagua. "Automatic quantification framework to detect cracks in teeth." In *SPIE Medical Imaging: Biomedical Applications in Molecular, Structural, and Functional Imaging*, 2018.
4. G. Brunner, **D.R. Chittajallu**, U. Kurkure, and I.A. Kakadiaris, "Patch-Cuts: A Graph-Based Image Segmentation Method Using Patch Features and Spatial Relations ", In *Proc. 21st British Machine Vision Conference (BMVC)*, pages 29.1-29.11, Aberystwyth, UK, Aug 30 – Sep 2, 2010.
5. **D.R. Chittajallu**, S. Shah, I.A. Kakadiaris, "A Shape-Driven MRF Model for the Segmentation of Organs in Medical Images," In *Proc. IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, pages 3233 – 3240, San Francisco, CA, 2010.
6. R. Yalamanchili, **D.R. Chittajallu**, P. Balana, B. Tamarappoo, D.S. Berman, D. Dey, and I.A. Kakadiaris. "Automated segmentation of the Diaphragm in non-contrast CT images," In *Proc. IEEE International Symposium on Biomedical Imaging: From Nano to Macro (ISBI)*, pages 900 – 903, Rotterdam, Netherlands, April 14-17, 2010.
7. **D.R. Chittajallu**, P. Balana, and I.A. Kakadiaris, "Automatic delineation of the inner thoracic region in non-contrast CT data," In *Proc. 31st International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, pages 3569 – 3572, Minneapolis, MN, Sep. 2-6 2009.
8. **D. R. Chittajallu**, G. Brunner, U. Kurkure, R. Yalamanchili, and I. A. Kakadiaris, "Fuzzy-cuts: A knowledge-driven graph-based method for medical image segmentation," In *Proc. IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, pages 715 – 722, Miami Beach, FL, 2009.
9. G. Brunner, **D.R. Chittajallu**, U. Kurkure, I.A. Kakadiaris, "A heart-centered coordinate system for the detection of coronary artery zones in non-contrast Computed Tomography data," *Proc. 2nd MICCAI Workshop on Computer Vision for Intravascular and Intracardiac Imaging*, New York, NY, Sept. 10, 2008.
10. U. Kurkure, **D.R. Chittajallu**, G. Brunner, R. Yalamanchili, and I.A. Kakadiaris, "Detection of coronary calcifications using supervised hierarchical classification," *Proc. 2nd MICCAI Workshop on Computer Vision for Intravascular and Intracardiac Imaging*, New York, NY, Sept. 10, 2008.
11. G. Brunner, U. Kurkure, **D.R. Chittajallu**, R. PC. Yalamanchili, I.A. Kakadiaris. "Toward unsupervised classification of calcified arterial lesions". *Proc. 11th International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)*, pages 144 – 152, New York, NY, Sept. 16-19, 2008.

AWARDS, HONORS AND ACHIEVEMENTS

- Recipient of the “Best PhD Award” 2010, Department of Computer Science, University of Houston, Texas, USA
- Was selected to showcase my Ph.D. research at the CVPR Doctoral Consortium for two consecutive years 2009 and 2010 which included a travel grant.
- My poster entitled "Fuzzy-cuts: A knowledge-driven graph-based method for medical image segmentation," was among 8 of the 73 posters selected for oral presentation at the International Computer Vision Summer School (ICVSS) 2009.
- Graduate Assistant Tuition Fellowship 2005 - 2010.
- Secured 1268th rank in the Entrance Examination for Undergraduate Admission (EAMCET - 2000) in the year 2000 out of a total of 150,000 students in the State.
- Secured 496th rank in Indian Institute of Information Technology (IIIT - HYDERABAD) entrance examination in the year 2000 out of a total of 50,000 students from all over India.
- Certificate of Merit in Mathematics Olympiad – 1997-98.

INVITED TALKS

- “HistomicsTK: An open-source python toolkit for web-based analysis of digital histopathology data”, PyData Carolinas, Sep 14-16, 2016.
- "Image Analysis Methods for Quantifying the Effects of Anti-Cancer Drugs at a Cellular Level in Live Mice Using Intravital Microscopy", IEEE International Symposium on Biomedical Imaging (ISBI) Special Session on Image-Based Representation and Modeling of Spatiotemporal Cell Dynamics, 2013.
- "Fuzzy-cuts: A knowledge-driven graph-based method for medical image segmentation", International Computer Vision Summer School (ICVSS), 2009.

PROFESSIONAL SERVICE

Reviewer

IEEE TIP, IEEE TMI, IEEE TBE, IEEE TBME, CVIU, Bioinformatics, Medical Image Analysis, FIMH, IEEE CVPR, IEEE ICCV, IEEE ISBI, ECCV, MMBIA,

SKILLS AND EXPERTISE

- **Specialties:** Computer Vision, Image Analysis, Machine Learning, Pattern Recognition, Data Mining, Discrete and Convex Optimization, Image Segmentation, Image Registration, Object Detection, Object Recognition, Object Tracking, Pattern Classification, Clustering, Regression, Markov Random Fields, Graph-cuts, Computer Aided Diagnosis, Medical Imaging, Algorithm Design, Artificial Intelligence, Probability and Statistics, Applied Mathematics
- **Languages, libraries, and tools:** C, C++, Matlab, Python, HTML, ITK, OpenCV, Caffe, Keras, Scikit-learn, Scikit-image, WEKA, CMake, Git, SVN.
- **Operating Systems:** Windows, Linux.

REFERENCES

Available upon request