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RESEARCH INTERESTS

My current research focuses on applications of image processing, computer vision, machine learning, pattern recognition and mathematical modeling in biological and biomedical image analysis and informatics.

I have been developing algorithms for histological tissue images analysis. My research includes developing automatic feature extraction and classification methods to solve object detection, object classification and image segmentation problems in histopathological tissue images.

EDUCATION

Jan 2013 - Dec 2017	**Ph.D. in Computer Science**, School of Computing, National University of Singapore. Singapore. **Thesis:** Automated Image Based Tools For Digital Pathology. **Research Area:** Digital Pathology, Computer Vision, Machine Learning. **Supervisors:** Dr. Hwee Kuan LEE and Prof. Wing-Kin SUNG, Ken.
Jul 2008 - Jun 2012	**B.Tech. in Information Technology (Hons.)**, Indian Institute of Information Technology Allahabad. Prayagraj, India. **Thesis:** Speech Retrieval. **Research Area:** Speech Processing, Information Retrieval, Machine Learning. **Supervisor:** Prof. Uma Shanker TIWARY.

AREAS OF EXPERTISE

- **Machine Learning:**
  Boosting, Deep Learning, Genetic Algorithms, Clustering, Pattern Recognition, *etc.*
- **Computer Vision:**
  Image Analysis, Image Segmentation.
- **Medical Imaging:**
  Digital Pathology problems of prominent nucleoli detection, gland segmentation, cancer assessment, immuno-phenotype quantification, multiplexed fluorescent image analysis, in histopathological images.

TECHNICAL STRENGTHS

Programming Languages	C, C++, Python, R, Java.
Software Packages	MATLAB, LaTeX, gnuplot, ImageJ, Oracle.
Libraries Explored	OpenCV, Caffe, TensorFlow, Keras, PyTorch, VTK, Boost C++ library.

RELEVANT COURSEWORK

Data and File Structures	Design And Analysis of Algorithms	Operating System
Database Management Systems	Advanced Modelling and Simulation	Computer Networks
Image Processing	Distributed Systems	Soft Computing
Information Retrieval	Uncertainty Modelling in AI	

WORK EXPERIENCE

Bioinformatics Institute (BII), Singapore. May 2021 - .

Post-doctoral Research Fellow at the Computer Vision and Pattern Discovery (CVPD) group of BII, Singapore.

Institute of Molecular and Cell Biology (IMCB), Singapore. May 2018 - April 2021.

Research Fellow *(Post-doctoral)* at the Computational & Molecular Pathology Lab (CMPL) of IMCB, Singapore.

National University of Singapore, Singapore August 2015 - December 2015.

Part Time Teaching Assistant at Department of Computer Science,

- Tutor for
  - CS3244 Machine Learning and
  - CS6205 Advanced Modelling and Simulation modules

  at Department of Computer Science, National University of Singapore.
- **Lecturers:** Prof. Chew Lim TAN and Dr. Hwee Kuan LEE.

University of Alberta, Canada May 2011 - July 2011.

Research Assistant in "Optimization of CO_2 Injectivity in Geological Carbon Storage" project with Prof. J. Fraser Forbes and Prof. Vinay Prasad.

- Implemented a model of oil reservoirs using MATLAB and studied the relation between well location and migration of CO_2 in depleted or near-depleted oil Reservoirs.
- Optimized the amount of Carbon Dioxide injected into the reservoir within the constraints of Parameters like Bottom Hole Pressure, Permeability and Porosity of rocks.
- Implemented the optimisation using both constrained non-linear programming and genetic algorithm based solvers in MATLAB.

DISSERTATIONS

National University of Singapore, Singapore January 2013 - December 2017
Supervisors: Dr. Hwee Kuan LEE and Prof. Wing-Kin SUNG, Ken.

- Developed an automated image based prominent nucleoli detection system for histopathological images.
- Developed a machine learning and image processing based automated system for gland segmentation in prostate histopathological images.
- Developed an automated image based grading system using nuclear patterns for renal histopathological images.

The above projects were implemented using C++, OpenCV, and Python. I primarily use C++ and Python for development purposes.

Indian Institute of Information Technology-Allahabad, India January 2012 - July 2012
Supervisor: Prof. Uma Shanker TIWARY

- Development of software using CMUSPhinx library, C++ and Java to transcribe a large amount of audio data into text format and facilitate search using audio queries.
- Use of multiple text document summarization based approach by incorporating human knowledge represented via fuzzy logic-based word-mesh and sentence-mesh.

PUBLICATIONS

1. Mustafa Umit Oner*, Mei Ying Ng*, Danilo Medina Giron, Cecilia Ee Chen Xi, Louis Ang Yuan Xiang, **Malay Singh**, Weimiao Yu, Wing-Kin Sung, Chin Fong Wong, Hwee Kuan Lee. **An AI-assisted Tool For Efficient Prostate Cancer Diagnosis**. bioRxiv 2022.02.06.479283; *Equal contribution. Dataset and Code(GitHub). PDF.
2. **Malay Singh**, Laurent Gole, Kok Haur Ong, Longjie Li, Xinmi Huo, Hao Han, Kah Weng Lau, Li Mei Gan, Char Loo Tan, David M Young, Hwee Kuan Lee, Susan Swee Shan Hue, Weimiao Yu, Soo Yong Tan. **Highly multiplexed immuno-fluorescence images data analysis for prostate cancer**. Poster at "Frontiers in Cancer Science 2021". FCS2021.
3. **Malay Singh**, Laurent Gole, Kok Haur Ong, Hao Han, David M Young, Susan Swee Shan Hue, Soo Yong Tan, Weimiao Yu. **Highly multiplexed immuno-fluorescence images data analysis for prostate cancer**. Poster at "Frontiers in Cancer Science 2020". FCS2020.
4. **Malay Singh**, Emarene Mationg Kalaw, Wang Jie, Mundher Al-Shabi, Chin Fong Wong, Danilo Medina Giron, Kian-Tai Chong, Maxine Tan, Zeng Zeng and Hwee Kuan Lee. **Cribriform pattern detection in prostate histopathological images using deep learning models.** arXiv pre-print, 1910.04030. PDF.
5. Daniel Aitor Holdbrook*, **Malay Singh***, Yukti Choudhury, Emarene Mationg Kalaw, Valerie Koh, Hui Shan Tan, Ravindran Kanesvaran, Puay Hoon Tan, John Yuen Shyi Peng, Min-Han Tan, and Hwee Kuan Lee. **Automated Renal Cancer Grading Using Nuclear Pleomorphic Patterns**. JCO Clinical Cancer Informatics 2018 :2, 1-12. *Equal contribution. PDF.
6. Oleg V. Grinchuk, Surya Pavan Yenamandra, Ramakrishnan Iyer, **Malay Singh**, Hwee Kuan Lee, Igor V. Kurochkin, Kiat Hon Lim, Pierce K. H. Chow, and Vladimir A. Kuznetsov. **Tumor-adjacent tissue co-expression profile analysis reveals pro-oncogenic gene signature for prognosis of resectable hepatocellular carcinoma**. Molecular Oncology 12(1):89-113, 2018. PDF.
7. Brandon Ryan Hong, **Malay Singh**, Jane Vin Chan, Matan Thangavelu, Giridharan Periyasamy, Hwee Kuan Lee, and Judice L. Y. Koh. **Predicting Drug Response in 3D Tumor Spheroids using Convolutional Neural Networks**. Poster at "EMBL Symposium: Seeing is Believing - Imaging the Process of Life". EMBL Heidelberg, Germany. October 2017.

8. **Malay Singh**, Zeng Zeng, Emarene Mationg Kalaw, Danilo Medina Giron, Kian-Tai Chong, and Hwee Kuan Lee. **A Study of Nuclei Classification Methods in Histopathological Images**. International Conference on Innovation in Medicine and Healthcare (KES-InMed-17). Springer, 2017. PDF.
9. **Malay Singh**, Emarene Mationg Kalaw, Danilo Medina Giron, Kian-Tai Chong, Chew Lim Tan, and Hwee Kuan Lee. **Gland Segmentation in Prostate Histopathological Images**. Journal of Medical Imaging: 4(2), 027501, 2017. PDF.
10. Choon Kong Yap, Emarene M. Kalaw, **Malay Singh**, Kian-Tai Chong, Danilo M. Giron, Chao-Hui Huang, Li Cheng, Yan Nei Law, and Hwee Kuan Lee. **Automated Image Based Prominent Nucleoli Detection**. Journal of Pathology Informatics 6.1. 2015: 39. PDF.
11. **Malay Singh**, Uma Shanker Tiwary, and Tanveer J. Siddiqui. **A Speech Retrieval System based on Fuzzy logic and Knowledge-base filtering**. In Proceedings of International Conference on Multimedia, Signal Processing and Communication Technologies (IMPACT), 2013 , pp. 46-50. IEEE, 2013. PDF.
12. Anupam Srivastava, Divij Vaidya, **Malay Singh**, Pranjal Singh, and Uma Shanker Tiwary. **A Cognitive Interactive Framework for Multi-Document Summarizer**. Advances in Intelligent Systems and Computing, 1, Volume 179, Proceedings of the Third International Conference on Intelligent Human Computer Interaction (IHCI 2011), Prague, Czech Republic, August, 2011, Part 5, Pages 257-268. PDF.

DATE: February 12, 2022