Saradha Venkatachalapathy

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SUMMARY

Ph.D. student at the Mechanobiology Institute, NUS specializing in genomics and computer vision. Extensive background in implementing statistical models to interpret causality in highly variable processes. Proven expertise in fluorescent microscopy and developing computer vision algorithms. Experienced in leading interdisciplinary collaborative projects with biologists and mathematicians to guide the design of experiments and modeling.

EDUCATION AND WORK EXPERIENCE

Ph.D, Mechanobiology | National University of Singapore | GPA 4.7/5 *Sep 2016 - Present*
B.Tech Biotechnology (Distinction) | SASTRA University | GPA 8.1/10 *Jul 2011 - May 2015*
Research Assistant, National University of Singapore *Sep 2015 - Jul 2016*

SKILLS

Statistics: Machine Learning, Linear Algebra, Regression, Diffusion maps and Pattern recognition.
Computer Vision: Segmentation, Feature generation and Particle tracking
Computational Biology: Analysis of bulk and single cell Microarray, RNA-Seq and HiC.
Experimental Skills: Microscopy, Tissue engineering and mechanical manipulation of cells.
Tools: R, ImageJ, MATLAB, Python (pandas, scikit, PyTorch),QuPath SQL, Git, LaTeX and Inkscape.

SELECTED RESEARCH PROJECTS

Automated feature generator for 3D images

- Built an in-house automatic image processing pipeline for segmentation and feature generation.
- Developed novel parameters that measure morphology, textural and spatial distribution of objects.
- Integrated multi-domain features such as protein expression, RNA seq and image features for deducing functional links.
- This reduced the processing time from 48 hours to 3 hours.

Deconvolving cell variability in cancer

- Only a subset of cells are activated by cancer signals in engineered breast cancer tissue.
- Developed a linear classifier to predict cell shape with an accuracy of 95%.
- Established the existence of activation primed cell shapes using multimodal-multivariate analysis.
- Demonstrated a causal relationship between cell geometry and activation *[MBoC,2020].*

Time series analysis of reprogramming

- Developed a novel method to reprogram fibroblasts to iPSC-like cells.
- Aligned, analyzed and visualized the transcriptome during mechanically induced de-differentiation. Performed statistical tests and pathway analysis to characterize the temporal changes in the transcription profile and infer the biological relevance *[PNAS,2018].*
- Implemented pseudo-temporal ordering of single cell data to identify variable trajectories during the generation of stem cells.

DNA structure informs its function

- Predicted DNA structure from integrating RNA-Seq and ChIP-Seq data and validated the robustness using experiments and HiC data *[PNAS,2017].*
- Identified latent immune cells based on image based DNA structures and clustering large single cell RNA-Seq dataset *[bioRxiv,2019].*

Cell shape modulates cellular response to stimuli

- Aligned, analyzed, visualized and interpreted differential gene expression patterns in RNA-Seq and microarray data. Also performed statistical tests and pathway analysis.
- Demonstrated the cell shape can modulate the transcriptional response to compressive load and inflammation *[PNAS, 2017][MBoC, 2018].*

Identification of dead (Apoptotic) cancer cells in a high-content screen

- Setup preliminary high content screen to characterize cancer cell survival in the presence of various drugs.
- Developed automatic image feature extraction from high content drug screens on cancer cells.
- Deployed multiple machine learning methods for classifying cancer cells as either dead (apoptotic) or live. Achieved identification accuracy of over 90%.

HONORS AND AWARDS

- Dean's Merit list given to the top 2-10% students in the University *2015*
- Inspirational Mentorship Award, NUS High School *2017*
- Best Oral Presentation Award, Genomes and AI: From Packing to Regulation *2019*

PAST EXPERIENCES

Intern, *Biophysics laboratory*, Raman Research Institute (RRI) *Winter, 2013*
Developed algorithms to identify and track vesicles in axons.

Medical Intern, *Kanmani Fertility Clinic*, Raju Hospitals *Summer, 2013*
Performed androgen characterisation, leukocyte culture, karyotyping and follicular study on patient samples.

Undergraduate researcher, *Chromatin Epigenetics laboratory*, SASTRA University *2012-2014*
Developed algorithms to identify apoptotic cells with an accuracy of over 90% in a high content screen.

LEADERSHIP AND TEACHING EXPERIENCE

- Designed and instructed a workshop session-Image Analysis for dummies *May, 2015*
- Teaching Assistance for MATLAB Programming- Bootcamp for Mechanobiology *August, 2017*
- Teaching Assistance for module Nuclear Mechanics and Genome Regulation *Jan 2016 - Apr 2016*
- Teaching Assistance for Nuclear Mechanics and Genome Regulation *Jan 2016 - Apr 2016*
- Supervised and mentored 5 students in the lab towards their thesis.

CONFERENCE: TALKS AND POSTERS

7. 64th Annual Biophysical Society Meeting *San Diego, Feb 2020*
   Talk:"Cell Geometry Modulates the Activation of Fibroblasts in 3D Tumor Microenvironment
6. Drug Discovery 2019 – Looking Back To The Future *Liverpool, Nov 2019*
   Talk: Invited Speaker:"Mechano-Genomics: from Cell-Fate Decisions to Biomarkers"
5. International Conference on Genomes and AI: From Packing to Regulation *Singapore, Oct 2019*
   Talk: "Multivariate analysis of fibroblast activation in engineered 3D tumor microenvironments"
4. Mechanobiology after 10 Years: The Promise of Mechanomedicine *Singapore, Nov 2018*
   Poster: "Heterogeneity in cell geometric states regulate the selective activation of fibroblasts"
3. Nuclear Mechanogenomics, EMBO Workshop *Singapore, Apr 2018*
   Talk: Role of cell geometry and 3D chromatin structure in differential genome regulation"
2. The 3rd International Symposium on Mechanobiology *Singapore, Dec 2017*
   Talk: "Role of 3D chromatin architecture in differential genome regulation"
1. Mechanobiology of Disease, MBI-BioPhysical Society meeting *Singapore, Sep 2016*
   Poster: "Nuclear positioning and its translation dynamics is regulated by cell geometry"

PEER REVIEWED PUBLICATIONS

6. **Venkatachalapathy S**, Jokhun DS, and Shivashankar GV. Multivariate analysis reveals activation-primed fibroblast geometric states in engineered 3D tumor microenvironments.*M*ol. Biol. Cell.2020;:mbcE19080420. [PMID:32023167]
5. Damodaran K*, **Venkatachalapathy S***, Alisafaei F, Radhakrishnan AV, Sharma Jokhun D, Shenoy VB, and Shivashankar GV. Compressive force induces reversible chromatin condensation and cell geometry dependent transcriptional response.*M*ol. Biol. Cell.2018;:mbcE18040256. [PMID:30256731]

4. Roy B, **Venkatachalapathy S**, Ratna P, Wang Y, Jokhun DS, Nagarajan M, and Shivashankar GV. Laterally confined growth of cells induces nuclear reprogramming in the absence of exogenous biochemical factors.*P*roc. Natl. Acad. Sci. U.S.A.2018;. [PMID: 29735717]
3. Belyaeva A, **Venkatachalapathy S**, Nagarajan M, Shivashankar GV, and Uhler C. Network analysis identifies chromosome intermingling regions as regulatory hotspots for transcription.*P*roc. Natl. Acad. Sci. U.S.A. 2017;.[PMID:29229825]
2. Mitra A, **Venkatachalapathy S**, Ratna P, Wang Y, Jokhun DS, and Shivashankar GV. Cell geometry dictates TNFα*A*-induced genome response.*P*roc. Natl. Acad. Sci. U.S.A.2017;[PMID:28461498]
1. Radhakrishnan AV, Jokhun DS, **Venkatachalapathy S**, and Shivashankar GV. Nuclear Positioning and Its Translational Dynamics Are Regulated by Cell Geometry. *B*iophys.J.2017;112(9):1920-1928.[PMID:28494962]

* indicates equal contribution
Complete List of publications: Here