

CONTACT
INFORMATION

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Visa: Authorized to work in the US
(Green Card holder)

PROFILE

Research scientist and data scientist experienced in the industrial field of nanotechnology, biotechnology and drug discovery over ten years, and capable of handling various types of data, proven over multiple multidisciplinary projects

I have a broad spectrum of research experiences as an experimental physicist, a microfluidics specialist, a computational biologist, a genomic data analyst, and an AI data scientist. And I have contributed to multiple company projects with patents, high-impact journal papers, and client engagements in IBM and PsychoGenics.

RESEARCH
INTERESTS

healthcare system based on deep learning computer vision/classification with novel sensor devices; IoT time-series data analysis in healthcare domain; Computer-vision research on human/animal behavioral pattern analysis; Gene sequence analysis for disease diagnosis from single-cell, extracellular vesicles; liquid biopsy

AWARDS

- IBM Outstanding Technical Achievement Award, “nanoDLD technology for biomarker isolation from liquid biopsies”, Watson Research Center, NY (2019)
- IBM “5 in 5” groundbreaking research award, Watson Research Center, NY (2017)

KEY SKILLS

Software Skills

- **Machine learning:** Classification, Ensemble learning, Statistical Learning, Regression Modeling, Multi-dimensional data clustering
- **Time-series data:** Healthcare/IoT data classification/prediction, Anomaly detection, LSTM model, Autoregressive integrated moving average (ARIMA)
- **Computer Vision:** Deep-learning object detection / segmentation (R-CNN, Unet), Video image analysis, Traditional segmentation techniques
- **Genomic data:** Next generation sequencing (NGS) pipeline, small RNA sequencing, STAR, bowtie, bwa, Biopython, limma, DeSeq2
- **Computational Fluid Dynamics (CFD):** OpenFOAM, COMSOL
- **Programming Languages:** Python (OpenCV, TensorFlow, Pytorch, PyQt; +8 years), R (Caret, Bioconductor; +3 years), C/C++, IDL, LaTeX
- **Operating Systems:** Linux (RHEL, Ubuntu - System Administrator), MacOS, Windows

Hardware Skills

- Signal measurement: Patch-clamp, NI-DAC board
- Microscopy: Fluorescence microscope, Optical tweezers
- Single-boards computer: Arduino, Raspberry Pi, Odroid

EMPLOYER
HISTORY

PsychoGenics, Paramus, NJ USA

Sr. Data Scientist, Jul 2020 - Current

AI Data Scientist and deep learning computer vision specialist on medical data

- Sematic segmentation and object detection on animal behavior recordings and image data management for the deep learning annotation/augmentation/training
- Gait pattern analysis of the mouse model using deep learning image segmentation/object detection algorithm for the development of neuropsychiatric drug
- Hardware development for the mouse behavior assessment (high-resolution multi-sensor system)

- Develop statistical algorithms to classify and cluster high-dimensional experimental data
- Prototype software development (hardware control and data acquisition - data analysis/analysis pipeline control - front end user interface)

IBM T.J. Watson Research Center, Yorktown Heights, NY USA

Data Scientist/Research Staff Member, Aug 2018 - Jun 2020

Healthcare Data Scientist and Genomic Data Analyst

- Gait pattern analysis of 3D accelerometer signals from daily walk activities and building ML model to predict clinical test scores
- Development of new statistical learning algorithm based on Fermi-Dirac distribution and validation on real-world data (Kaggle, UCI data set)
- Bio-marker detection from circulating extracellular vesicle using small RNA sequences and pipeline development for unannotated small RNA cluster
- Time-series clinical data analysis and development of software framework for establishing baseline signals including molecular information and patient logs

Biophysicist/Postdoctoral position, Nov 2014 - Jul 2018

Microfluidics specialist and computational biophysicist

- Modeling and optimizing next generation nanoscale Deterministic Lateral Displacement (nanoDLD) device for high volume and high purity using computational fluid dynamics (CFD) simulations and experiments
- Development of fluid dynamics theory to explain complex dynamics of biological materials in a nanoDLD device (including DNA for Next Generation Sequencing, Exosome for liquid biopsy)
- Development of the cell simulator to study protein mobility inside a cell using Levy flight model and validation with video microscopy
- Building software libraries for image analysis of microfluidics phenomena and biological activities (including trajectories of fluorescent beads, DNA and exosome in a nanoDLD / dyed protein trajectories in a cell)
- Development of portable hardware using micro-boards to analyze clinical experiments (pupae counter for cancer drug tests)
- Modeling and optimizing resistive pulse sensing (RPS) device for integrated sensing device

IBM Research Australia, Melbourne, VIC Australia

Microfluidics Specialist/Research Staff, Jan 2013 - Nov 2014

Experiment Designer and Continuum Simulation Specialist

- Nanopore experiments with proteins (BSA, DHPS)
- Ionic current calculation of the nanopore with different geometry by solving Poisson-Nernst-Planck and Navier-Stokes equations using OpenFOAM
- Simulation of the full 3D model of nanopore and a protein inside
- Continuum simulation of nanofluidic devices (nanopore, nanoDLD)
- Simulation of particle trajectories inside nanofluidic devices with discrete element methods
- Experiences with IBM high performance computer at VLSCI (Victorian Life Science Computation Initiative) and cluster computer at IBM Research Melbourne (Intel and Power-based machines)

University of Melbourne, Melbourne, VIC Australia

Honorary Fellow, May 2013 - Oct 2014

Microfluidics Specialist

IBM T.J. Watson Research Center, Yorktown Heights, NY USA

Physicist/Postdoctoral position, Aug 2012 - Dec 2012

Experimental Physicist and Nanopore Specialist

- Nanopore experiments with coated nanopore and proteins (Streptavidin and Biotin)
- Fabrication of nanopores on SiN and SiO membranes using TEM machine
- Ionic current analysis of synthetic Biotin-derivative coated nanopore and proteins (BSA, DHDPS)
- Analysis of noise spectrum and stability of baseline current using TEM- and FIB-drilled nanopores
- Modeling of particle capturing event and ionic current modulation of a coated nanopore

TRAINING

- IBM AI Skills Academy Technical Role Practitioner, IBM (2019)
- Improving Deep Neural Networks: Hyperparameter tuning, Regularization and optimization, Coursera (2020)
- Convolutional Neural Networks, Coursera (2019)
- Sequence Models, Coursera (2019)
- Structuring Machine Learning Projects, Coursera (2019)
- Introduction to Genomic Technologies, Coursera (2019)
- Bioconductor for Genomic Data Science, Coursera (2019)

QUALIFICATIONS

Brown University, Providence, RI USA, Ph.D. Physics, May 2012

- Thesis Title: *Transport of charged colloids and DNA in micro-channels.*
- Adviser: Professor Xinsheng Sean Ling
- Area of Study: Colloid Crystal, Nanochannel, DNA Sequencing

Seoul National University, Seoul, South Korea, B.S. and M.S., Physics, Feb 2006

- Thesis Title: *Geometrical and electrical structure of the co-deposited silicon surface (100) with Nickel and Gold*
- Adviser: Professor Young Kuk
- Area of Study: STM

PUBLICATIONS

- [1] Sung-Cheol Kim, Adith S Arun, Mehmet Eren Ahsen, Robert Vogel, Gustavo Stolovitzky "The Fermi–Dirac distribution provides a calibrated probabilistic output for binary classifiers" *PNAS* 118 (34), (2021)
- [2] Johann Von Felden, Teresa Garcia-Lezana, Navneet Dogra, Edgar Gonzalez-Kozlova, Mehmet Eren Ahsen, Amanda Craig, Stacey Gifford, Benjamin Wunsch, Joshua T Smith, Sungcheol Kim, Jennifer EL Diaz, Xintong Chen, Ismail Labgaa, Philipp Haber, Reena Olsen, Dan Han, Paula Restrepo, Delia D'Avola, Gabriela Hernandez-Meza, Kimaada Allette, Robert Sebra, Behnam Saberi, Parissa Tabrizian, Amon Asgharpour, Douglas Dieterich, Josep M Llovet, Carlos Cordon-Cardo, Ash Tewari, Myron Schwartz, Gustavo Stolovitzky, Bojan Losic, Augusto Villanueva "Unannotated small RNA clusters associated with circulating extracellular vesicles detect early stage liver cancer" *Gut* (2021)
- [3] Benjamin H Wunsch, Kuan Yu Hsieh, Sung-Cheol Kim, Michael Pereira, Stanislav Lukashov, Chris Scerbo, John M Papalia, Elizabeth A Duch, Gustavo Stolovitzky, Stacey M Gifford, Joshua T Smith "Advancements in Throughput, Lifetime, Purification, and Workflow for Integrated Nanoscale Deterministic Lateral Displacement" *Advanced Materials Technologies* 6 (4), (2021)
- [4] Axel Hochstetter, Rohan Vernekar, Robert H. Austin, Holger Becker, Jason P. Beech, Dmitry A. Fedosov, Gerhard Gompper, Sung-Cheol Kim, Joshua T.

Smith, Gustavo Stolovitzky, Jonas O. Tegenfeldt, Benjamin H. Wunsch, Kerwin K. Zeming, Timm Krüger, David W. Inglis “Deterministic Lateral Displacement – Challenges and Perspectives” *ACS Nano* 14 (9), (2020)

[5] Sung-Cheol Kim, Lichao Yu, Alexandros Pertsinidis, and Xinsheng Sean Ling “Dynamical processes of interstitial diffusion in a two-dimensional colloidal crystal” *PNAS* 117 (22), (2020)

[6] Sung-Cheol Kim, Benjamin H. Wunsch, Stacey M. Gifford, Yann Astier, Chao Wang, Robert L. Bruce, Jyotica, Elizabeth A Duch, Simon Dawes, Gustavo Stolovitzky, Joshua T Smith “Gel-on-a-chip: continuous, velocity-dependent DNA separation using nanoscale lateral displacement” *Lab on a Chip* 19 (9), P1567–1578 (2019)

[7] Sung-Cheol Kim, Benjamin H. Wunsch, Huan Hu, Joshua Smith, Robert H. Austin, Gustavo Stolovitzky “Broken flow symmetry explains the dynamics of small particles in deterministic lateral displacement arrays” *PNAS* 114 (26), E5034–5041 (2017)

[8] Sung Cheol Kim, Sridhar Kannam, Stefan Harrer, Matthew Downton, Stephen Moore, John Wagner “Geometric dependence of the conductance drop in a nanopore due to a particle” *Physical Review E*. 89 (4), 042702 (2014)

Full list of publications :

<https://scholar.google.com/citations?user=p2KYYIQAAAAJ&hl=en&authuser=1>

PAPERS IN PREPARATION

[1] Adith S Arun, Sung-Cheol Kim, Mehmet Eren Ahsen, Gustavo A Stolovitzky “Correlated Drug Action as a Baseline Additivity Model for Combination Cancer Therapy in Patient Cohorts and Cell Cultures” *bioRxiv* (2021)

SELECTED PATENTS

[1] Deterministic lateral displacement arrays, 15971348, US (2018)

[2] Detection of nucleic acid sequences using deterministic lateral displacement arrays, 16007347, US (2019)

[3] Multistage deterministic lateral displacement device for particle separation, 16007107, US (2019)

[4] Microfluidic chips for particle purification and fractionation, 15875905, US (2019)

[5] Microscale and mesoscale condenser devices, 15875862, US (2019)

[6] Nanopore coating for sensing chemical bond formation, 16111258, US (2020)

PRESENTATION AND CONFERENCES

Invited Seminars

- Micro-nano Seminar, MIT, Boston, MA (2018)
- Special Condensed Matter and Biophysics Seminar, Brown University, Providence, RI (2018)

Conference Presentations

- “Broken flow symmetry explains the dynamics of small particles in deterministic lateral displacement arrays” NCS8, New York, NY (2018)
- “On-chip liquid biopsy: Progress in isolation of exosomes for early diagnosis of cancer” BPS Meeting, New Orleans, LO (2017)
- “Quantitative modeling of spatio- temporal properties of enzyme clusters”, NY/BIG, New York, NY (2017)

	<ul style="list-style-type: none"> • “Modeling protein diffusion in the cell membrane with Levy flight” BPS Meeting, Los Angeles, CA USA (2016) • “Shaping the Future of Nanomedicine; Next-Generation Drug Screening, Development and Discovery” W.E. Heraeus Seminar, Bremen, Germany (2013)
OTHER ACTIVITIES	<ul style="list-style-type: none"> • Participation in the coding and debugging of the open-source Quantum Computing Software Development Framework (Qiskit) - Korean translation • Professional book translation (Korean) - “Introducing Design Automation for Quantum Computing”, Zulehner et al., Springer (2020)
COMMUNITY ACTIVITIES	<ul style="list-style-type: none"> • Mentoring a summer intern (2019) • Organizing internal small-group lecture series - “GitHub for scientist” (2019) • A representative of Korean IBM researcher association (2019-2020)
PROFESSIONAL ORGANIZATIONS	<ul style="list-style-type: none"> • Member of American Physical Society • Member of Biophysical Society
REFERENCES	<p>Gustavo A. Stolovitzky (e-mail: gustavo.stolo@gmail.com; phone: +1-646-296-5780)</p> <ul style="list-style-type: none"> • Chief Science Officer, Sema4 ◇ 333 Ludlow Street, North, Tower 8th floor, Stamford, CT 06902 <p>Navneet Dogra (e-mail: navneet.dogra@mssm.edu; phone: +1-570-909-8473)</p> <ul style="list-style-type: none"> • Assistant Professor, Genetics and Genomic Sciences • Assistant Professor, Pathology, Molecular and Cell Based Medicine ◇ 1 Gustave L. Levy Place, New York, NY 10029-5674 <p>Stefan Harrer (e-mail: harrerbua@gmail.com; phone: +62-3-9921-3878)</p> <ul style="list-style-type: none"> • Chief Innovation Officer, Digital Health Cooperative Research Center (DHCRC) ◇ YBF Ventures, 520 Bourke Street, Melb, VIC, Australia <p>Xinsheng Sean Ling (e-mail: xsling@brown.edu; phone: +1-401-863-2582)</p> <ul style="list-style-type: none"> • Professor, Physics, Brown University ◇ 184 Hope St., Providence, RI 02912 USA <p>Robert H. Austin (e-mail: austin@princeton.edu; phone: +1-609-258-4353)</p> <ul style="list-style-type: none"> • Professor, Physics, Princeton University ◇ 122 Jadwin Hall, Princeton, NJ 08544 USA