Stas Tiomkin, PhD

Assistant Professor in Computer Science
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Research Interests

Artificial Intelligence, **R3** Learning (**R**einforcement, **R**epresentation, **R**obot), Control & Information Processing in Multimodal Perception-Action Systems, Intrinsic Motivation, Morpho-Control Intelligence, Emergence of Interaction

Lab: *'**C**omputational **I**ntelligence, **C**ontrol & **I**nformation', **CI**^{2}, WCoE, TTU.*

Academic Appointments

current-Aug 2024 Assistant Professor (tenure track), Department of Computer Science, Whitacre College Of Engineering, Texas Tech University, Lubbock, Texas.

Aug 2024-Aug 2021 Assistant Professor (tenure track), Department of Computer Engineering, Davidson College Of Engineering, San Jose State University, California.

Education and Training

2021 Post-Doctorate in Berkeley Artificial Intelligence Research (BAIR), 'Robot Learning Lab' by Professor Pieter Abbeel University of California at Berkeley, CA.

2019 PhD. Dissertation topic: 'Intrinsic Motivation - An Information Theoretic Approach' Hebrew University at Jerusalem, advisors: Prof Naftali Tishby and Prof Daniel Polani.

2018 Visiting Research Fellow in 'The Institute for Quantitative Theory and Methods', Professor Ilya Nemenman's Lab Emory University, Atlanta, GA.

2008 MSc. Thesis topic: 'Statistical Text to Speech Synthesis' Dept. of Electrical and Computer Engineering, Technion I.I.T, Israel. advisor: Prof David Malah

2005 BSc (double major), Computer Engineering and Physics Hebrew University, Israel.

Selected Grants and Awards

Mar 2025 NSF CRII in Robust Intelligence, Division of Information and Intelligent Systems
PI 'Interpretable Framework and Transformative Applications for Viability in Autonomous Agents'; Award number: 2513350; Award amount: $174,874.00.

Sep 2023 NSF CloudBank 22-087
PI Award amount: $34,597.00.

Oct 2023 PAZI Excellence in Science Foundation
CoPI 'Discovery and Utilization of Symmetries in Dynamical Systems'; Award amount: $32,000.00.

Feb 2022 Renault-Nissan-Mitsubishi Alliance Innovation Lab - Silicon Valley (AIL-SV)
PI 'Decision-Making, Control, and Reinforcement Learning in Robotics'; Award amount: $49,000.00.

Oct 2022 SGP, CoE SJSU
PI 'Control Theoretic Framework for Design and Analysis of Closed-Loop Brain Stimulation'; Award amount: $49,000.00.

Selected Publications (Full List at Google Scholar)

Royal Society: *Philosophical Transactions*
'Goals and the Structure of Experience' in 'Philosophical Transactions of the Royal Society A, (2025)' with Nadav Amir and Angela Langdon. Keywords: State Representation, Experience-Derived Goals, World Models.

J. Physics: *Complexity*
'Process Empowerment for Robust Intrinsic Motivation' in 'Journal of Physics: Complexity (2025)' with Christoph Salge and Daniel Polani. Keywords: Robust Intrinsic Motivation, Information Processing in Dynamics.

AAAI 2025
'Bootstrapped Reward Shaping' in 'Proceedings of the AAAI Conference on Artificial Intelligence (AAAI-25)' with Jacob Adamczyk, Volodymyr Makarenko, Rahul Kulkarni. Keywords: Reward Shaping, Reinforcement Learning.

ICRA 2025
'SuPLE: Robot Learning with Lyapunov Rewards' in 'International Conference on Robotics and Automation (ICRA)' with Phu Nguyen, Daniel Polani. Keywords: Robot Learning, Reinforcement Learning, Lyapunov Rewards.

PRX Life 24
'Intrinsic Motivation in Dynamical Systems' in 'PRX Life - Physical Review Journals, APS' with Ilya Nemenman, Daniel Polani, Naftali Tishby. Selected to be one of five spotlight papers, featured at the Global Physics Summit in Anaheim, CA, March 2025. Keywords: Empowerment, Channel Capacity, Lyapunov Exponents.

UAI 23
'Bounding the Optimal Value Function in Compositional Reinforcement Learning' in 'Uncertainty in Artificial Intelligence' with Jacob Adamczyk, Volodymyr Makarenko, Argenis Arriojas, Rahul V. Kulkarni. Acceptance rate, 30%. Keywords: theoretical bounds on compositionality.

UAI 23
'Bayesian Inference Approach for Entropy Regularized Reinforcement Learning with Stochastic Dynamics' in 'Uncertainty in Artificial Intelligence' with Argenis Arriojas, Jacob Adamczyk, Rahul V. Kulkarni. Spotlight acceptance rate, 3%. Keywords: exact Bayesian inference in Markov Decision Processes with stochastic dynamics.

AAAI 23
'Utilizing Prior Solutions for Reward Shaping and Composition in Entropy-Regularized Reinforcement Learning' in 'Thirty-Seventh AAAI Conference on Artificial Intelligence' with Jacob Adamczyk, Argenis Arriojas, Rahul V. Kulkarni. Acceptance rate, 19%. Keywords: theoretical bounds on transfer learning, compositionality in entropy-regularized RL.

PRR 23
'Entropy Regularized Reinforcement Learning using Large Deviation Theory' in 'Physical Review Research, American Physical Society' with Argenis Arriojas, Jacob Adamczyk, Rahul V. Kulkarni. Q1 journal. Keywords: statistics of rare events in RL, non equilibrium statistical mechanics, free energy.

IROS 22
'Multi-Objective Policy Gradients with Topological Constraints' in 'IEEE International Conference on Intelligent Robots and Systems' with Kyle Hollins Wray, Mykel J. Kochenderfer, Pieter Abbeel. Acceptance rate, 47%. Keywords: robotics, deep multi-objective reinforcement learning, constrained policy gradients.

ICLR 21
'Efficient Empowerment Estimation for Unsupervised Stabilization' in 'International Conference on Learning Representations' with Ruihan Zhao, Kevin Lu, Pieter Abbeel. Acceptance rate, 28%. Keywords: representation learning of dynamical control systems, estimation of information channel capacity from images, intrinsic motivation.

NeurIPS 20 'AvE: Assistance via Empowerment' in 'Advances in Neural Information Processing Systems' with Yuqing Du, Emre Kiciman, Daniel Polani, Pieter Abbeel, Anca Dragan. Acceptance rate, 20%. Keywords: Human-AI intrinsic interaction, deep reinforcement learning, control of partially-controllable machinery, user study.

CDC 15 'Past-future Information Bottleneck for Linear Feedback Systems' in '54th IEEE Conference on Decision and Control' with Amir Nadav and Naftali Tishby. Keywords: information bottleneck, complexity of dynamical control systems.

Service

NSF Panelist Various Programs

Reviewer NeurIPS, IEEE, ICLR, ICRA, IROS, UAI, AAAI, ICML, eLife, PRX Life, IEEE Transactions, J.Phys: Complexity

Area Chair NeurIPS 2024, ICML 2025, NeurIPS 2025

Aug24-current Graduate Admission Committee at CS Dept., Texas Tech.

Aug23-Aug24 Graduate Studies Committee at College of Engineering, SJSU.

Aug21-Aug24 Graduate Studies Committee at Computer Engineering, CoE, SJSU.

Jul22-Aug23 Research Committee at College of Engineering, SJSU.

Mentoring PhD Students

Graduated / Current

Spring 2025 - current Tristan Shah; research direction: " Control, information, and intrinsic motivation for efficient robot learning".
keywords: information capacity, intrinsic motivation, robot learning, diverse intelligence

Spring 2025 - current Wooyoung Chung; research direction: "Control, information processing, and learning on manifolds".
keywords: group theory, information bottleneck, multimodal perception-action cycle.

Spring 2025 - current Noam Smilovich; research direction: "Control and Intrinsic Motivation in Hybrid Dynamics"
keywords: diverse intelligences, empowerment in switching systems, smart meterials.

Fall 2025 - current Joshua Huang; research direction: "Towards General Robotic Intelligence"
keywords: perception-reasoning-action loop, robotics, robot learning.

Mentoring Master Students

Graduated / Current

Fall 2023 Suruchi Sharma; topic: 'Controllability-Constrained Deep Neural Network Models for Enhanced Control of Dynamical Systems'
keywords: control-theoretic constraints on deep networks, dynamics learning from images

Fall 2023 Johnny Liang; topic: 'Reinforcement Learning Methods for Efficient Cross-Training between Real and Simulated Robots in Cyber-Physical Systems'
keywords: robotics, sim2real, ensemble learning, cyber-physical system

Fall 2023 Fnu Ankur; topic: 'Reinforcement Learning with elements of group theory and symmetries'
keywords: deep RL, group theory, symmetry, sample efficiency, equvariance

Fall 2023 Phu Nguyen; topic: 'Intrinsic Motivation by the Principles of Non-Linear Dynamical Systems'
keywords: unsupervised learning, estimation of Lyapunov Exponents, intrinsic motivation

Fall 2023 Alavi Khan; topic: 'Exploring the Design Space of Simulated Robotic Arms with Tactile Stimuli for Object Manipulation using Reinforcement Learning Methods'
keywords: multi-modal perception-action in robotic arms, reinforcement learning

Spring 2023 Ezgi Kaya; topic: 'Sample-based Learning of Hybrid Dynamical Systems'
keywords: hybrid dynamics, differential algebraic equations, implicit learning.

Spring 2023 Tristan Shah; topic: 'Wave Manipulation with Reinforcement Learning'
keywords: PDE control, reinforcement learning, acoustics, meta-materials

Spring 2023 Paul Mello; topic: 'Information Processing by Diffusion Processes'
keywords diffusion models, generative AI, information estimators, information bottlenecks

Spring 2023 Himaja Papala; topic: 'Decentralized traffic congestion control using self-motivated AI'
keywords: decentralized control, traffic dynamics, empowerment, transportation

Spring 2023 Wooyoung Chung; topic: 'Symmetry Discovery by Reinforcement Learning'
keywords: manifold learning, deep reinforcement Learning with geometric constraints

Fall 2024 Enosh Shrestha; topic: 'Learning to play via maximization of directed information' keywords feedback capacity, directed information, unsupervised reinforcement learning

Fall 2024 Ankit Pal; topic: 'Multimodal Intrinsic Motivation for Object Manipulation'
keywords: empowerment, unsupervised learning, multimodal sensor fusion, tactile, vision

Spring 2025 Vlad Makarenko; topic: 'Data Analysis with Information Theoretic Methods'
keywords: multivariate information bottleneck, capacity of neural models, generalization in neural models, reinforcement learning

Teaching

Undergrad / Grad

CS 5331 'Generative AI', Fall 25, Whitacre CoE, Texas Tech U.

CS 3368 'Intro to Artificial Intelligence', Spring 25, Whitacre CoE, Texas Tech U.

CS 5392 'Reinforcement Learning', Fall 24, Whitacre CoE, Texas Tech U.

CMPE 260 'Reinforcement Learning', Spring 22, 23, Fall 22, Davidson CoE SJSU.

CMPE 252 'Artificial Intelligence and Data Engineering', Fall 21, 22, 23, Spring 22, 23, Davidson CoE SJSU.

CMPE 260 'Reinforcement Learning', Spring 22, 23, Fall 22, Davidson CoE SJSU.

CMPE 188 'Machine Learning for Big Data', Fall 21, Davidson CoE SJSU.

CMPE 289 'Special Problems', Fall 22, 23, Spring 23, Davidson CoE SJSU.

CMPE 180 'Individual Study', Spring 22, Davidson CoE SJSU.

CMPE 295 'Graduate Engineering Project', Fall 21, 22, 23, Spring 22, 23 Davidson CoE SJSU.

CMPE 195 'Undergraduate Engineering Project', Fall 21, 22, 23, Spring 22, 23 Davidson CoE SJSU.

CS 76929 'Dynamical Systems and Control', Spring 13, 14, 15, CSE Hebrew University.

CS 67738 'Smart Systems', Fall 14, 15, 16, 17, CSE Hebrew University.

EE 44130 'Signals and Systems', Fall 05, 06, 07, Spring 05, 06, 07, ECE Technion.

EE Labs 'Signal and Image Processing', Fall 05, 06, 07, Spring 05, 06, 07 ECE Technion.

Supervising Student Projects

Undergrad / Grad

SP22-FL23 topic: 'Object manipulation by simulated robotic arms with tactile sensing'
SP22-FL23 topic: 'Model-free tracking utilizing properties of dynamical systems'
SP22-FL23 topic: 'Enhancement of Superway Transportation by Machine Learning Approaches'
SP22-FL23 topic: 'Optimization of the morphology of robotic arms'
SP22-FL23 topic: 'Information theoretical and physical quantities for unsupervised learning'
SP22-FL23 topic: 'Control of high-dimensional dynamics by sparse inputs and outputs'
SP22-FL23 topic: 'Robo - Trainer'
FL22-SP23 topic: 'Model-based reinforcement learning with geometric priors'
FL22-SP23 topic: 'Rolling Stones Play Go by Self-Learning'
FL22-SP23 topic: 'Investigation of latent factor analysis via dynamical systems'
SP23-FL23 topic: 'Scalable Multiple-Service Architecture for an Autonomous Cyber-Physical Platform'
FL22-SP23 topic: 'Development of autonomous CyberPhysical systems by reinforcement learning'
FL22-SP23 topic: 'Improving safety of intelligent car breaks by reinforcement learning methods'
FL22-SP23 topic: 'Information theoretic approach to decentralized control of traffic networks'
FL22-SP23 topic: 'Reinforcement learning approach to the design of acoustic meta-material'
SP23-FL23 topic: 'Large Scale Cyber Physical Platform for Artificial Intelligence Research'
SP23-FL23 topic: 'Unsupervised Learning with Information Theoretic methods'
FL23-SP24 topic: 'Multiple-Agent Reinforcement Learning for RoboCup Soccer Competition'
FL23-SP24 topic: 'Real-time Data Processing and Machine Learning in Cyber Physical systems'
FL23-SP24 topic: 'Classification of Pets in Natural Environment'
FL23-SP24 topic: 'Real-time monitoring and analysis of Air Quality with Embedded Devices'

Industrial Research, Development, and Leadership

www.VoiceItt.com

Jan 2019-Sep 2022 Co-Founder and Chief Technology Officer in 'VoiceItt Ltd.', developing advanced AI technology for social inclusion for people with disabilities.

"Ideas Change Everything"

TEDx Texas Tech

Invited Speaker in TED on *"What is Human-Centric Artificial Intellegnce?"*, *March 2025*.