ALEKSEI PETRENKO

Email: petrenko@usc.edu Phone: +1 (323) 961-17-12 Website: https://alex-petrenko.github.io
Based in: Los Angeles, USA Github: https://github.com/alex-petrenko

Reinforcement learning expert. Versatile researcher and programmer with deep expertise in C++, Python, software architecture, optimization, high-throughput systems, and parallel computing.

EDUCATION & RESEARCH

2018-present, USA:

Computer science PhD candidate at University of Southern California
Advisor: Prof. Gaurav Sukhatme, USC Robotic Embedded Systems Lab
Expected graduation: late 2022
Research interests: deep reinforcement learning, machine learning systems, high-throughput learning and simulation, distributed RL, multi-agent learning and self-play, robotics and sim-to-real.

2008-2014, Russia:

M. Sc. in Computer Science at Nizhny Novgorod State Technical University (5.0/5.0)
B. Sc. in Computer Science at Nizhny Novgorod State Technical University (4.95/5.0)

RECENT PUBLICATIONS

2022:

- **A Petrenko**, A Allshire, G State, A Handa, V Makoviychuk. "DexPBT: Scaling up Dexterous Manipulation for Hand-Arm Systems with Population Based Training." Submitted to ICRA 2023.
- A Handa*, A Allshire*, V Makoviychuk*, **A Petrenko***, R Singh*, J Liu*, D Makoviichuk, K Van Wyk, A Zhurkevich, B Sundaralingam, Y Narang, J Lafleche, D Fox, G State. "DeXtreme: Transfer of Agile In-hand Manipulation from Simulation to Reality." Submitted to ICRA 2023.

2021:

- **A Petrenko**, E Wijmans, B Shacklett, V Koltun. "Megaverse: Simulating Embodied Agents at One Million Experiences per Second." In ICML, 2021. Arxiv, Github, Website
- S Batra*, Z Huang*, **A Petrenko***, T Kumar, A Molchanov, G Sukhatme. "Decentralized Control of Quadrotor Swarms with End-to-end Deep Reinforcement Learning". In CORL, 2021. Arxiv, Github, Website
- S Hegde, A Kanervisto, **A Petrenko**. "Agents that Listen: High-Throughput Reinforcement Learning with Multiple Sensory Systems". In IEEE Conference on Games, 2021. Arxiv, Github, Website
- B Shacklett, E Wijmans, **A Petrenko**, M Savva, D Batra, V Koltun, K Fatahalian. "Large Batch Simulation for Deep Reinforcement Learning." In ICLR, 2021. Arxiv, Github

2020:

- **A Petrenko**, Z Huang, T Kumar, G Sukhatme, V Koltun. "Sample Factory: Egocentric 3D control from pixels at 100000 fps with asynchronous reinforcement learning". In ICML, 2020. Arxiv, Github, Website

SKILLSET

Reinforcement learning:

- I dedicated my PhD to studying deep reinforcement learning and its applications. I am an expert in high-throughput learning systems and parallel simulation who authored multiple open-source libraries.
- Studied and/or extended numerous RL and simulation frameworks: Sample Factory, RLLIB, OpenAI Gym, Baselines, Isaac Gym, IMPALA, DeepMind Lab, VizDoom, etc.

Programming languages:

- Expert C++ and Python programmer.
- C#, Java, Javascript (extensive experience in industry, proficient with some catching up)

Other skills:

- Software development and architecture. I create complex software systems from ground up: mobile, desktop, server-side, libraries, etc.
- Deep learning. ML in computer vision, model architectures, variational inference, generative models. Implemented and deployed numerous machine learning systems. Tools: PyTorch, Tensorflow, WandB, etc.
- Algorithms. Solid background from industry and programming competitions. Graph algorithms, computational complexity, data structures, etc. TA'ed undergraduate classes on algorithms in two Universities.
- Computer vision: OpenCV, depth sensors, point clouds, 3D data processing.
- Cloud, scalable services, clusters (AWS API, Docker, Slurm, NGC).
- 3D rendering (OpenGL, Unity3D, Magnum), and VR (Oculus).

EMPLOYMENT HISTORY

Robotics/AI Research Intern at NVIDIA **2021-2022, Los Angeles, USA**

Collaborated with Gavriel State, Ankur Handa, Viktor Makoviychuk, Erwin Coumans, and others on applications of GPU-accelerated physics in dexterous robotic manipulation and sim-to-real transfer. Large-scale reinforcement learning and population-based training for in-hand manipulation, as well as object grasping and placement with simulated high-DoF hand-arm systems.

This work resulted in two papers ("DeXtreme" and "DexPBT") submitted to ICRA 2023.

Technologies: Python, PyTorch, PhysX, Isaac Gym, Docker, WandB.

PhD Research Intern at Intel Labs **2020, Los Angeles, USA**

Worked with Vladlen Koltun on a high-throughput simulator for embodied AI research, capable of rendering 1,000,000 observations per second on a single machine. This project titled "Megaverse" was presented at ICML 2021.

Technologies: C++17, Python, PyTorch, Vulkan, OpenGL

PhD Research Intern at Intel Labs **2019, Santa Clara, USA**

Advised by Vladlen Koltun, developed a new asynchronous reinforcement learning system that can achieve up to 150000 FPS of training throughput on a single GPU. Using this framework, achieved new SOTA in VizDoom environments, including challenging multi-agent and self-play scenarios. Project titled "Sample Factory" was presented at ICML 2020.

Technologies: Python, PyTorch, TensorFlow, RLLib, Ray, OpenAI Gym, Slurm

Tech Lead at itSeez3D **2015-2018, Nizhny Novgorod, Russia**

Lead algorithms and systems developer in the computer vision startup, mainly focusing on AI-based human digitization engine called Avatar SDK.

- Developed deep learning methods for accurate 3D reconstruction of the human head from a single portrait photo
- R&D for the automatic generator of full-body characters (skeleton animation, rendering, deep learning)
- Optimized deep neural networks for deployment (quantization, compression, etc.)
- Worked on various applications for the avatar engine: mobile, desktop, and virtual reality. Developed and deployed interactive demos for major conferences and exhibitions: SIGGRAPH, GDC, VRX.

My avatar automatically created from a selfie by the Avatar SDK engine (circa 2016): https://skfb.ly/6FUYY

Key technologies:

- C++11/14 and OpenCV, Python, TensorFlow and Keras
- OpenGL, Unity & Unreal for 3D rendering, Oculus SDK + Unity for VR

Senior Software Engineer at itSeez **2013-2015, Nizhny Novgorod, Russia**

ItSeez was a company behind the computer vision OpenCV library where I was involved in the development of the first portable consumer 3D scanner.

- 3D scanning algorithms for various depth sensor platforms: Intel RealSense, Google Tango, Apple iPad + Occipital Structure Sensor, etc.

- Developed backend services for the 3D reconstruction pipeline
- Created mobile and desktop 3D scanning applications (iOS, Android, Linux, Windows)
- Algorithms for polygonal mesh and point cloud processing, filtering and refinement of noisy 3D data, algorithms that prepare meshes for 3D printing: mesh "hollowisation" (polygon offset), ensuring manifoldness, etc.

My full-body scan made with itSeez3D software: https://skfb.ly/CzyX

Technologies: C++, OpenCV, C# & Xamarin, Python, Django, AWS, Docker

Software Engineer at Tecom **2010-2013, Nizhny Novgorod, Russia**

Developed a big real-time (frame perfect) massively parallel broadcast automation system with many levels of redundancy. My responsibilities ranged from R&D to maintenance with emphasis on software architecture and optimization.

Technologies: C++/Qt, C#, Java, Javascript, Python, Linux.

SELECTED OPEN-SOURCE PROJECTS

- https://github.com/alex-petrenko/sample-factory at the time of release the fastest open-source PPO implementation
- https://github.com/alex-petrenko/megaverse embodied simulation for RL research at 1,000,000 FPS
- https://github.com/alex-petrenko/faster-fifo faster alternative to built-in Python multiprocessing.Queue
- https://github.com/alex-petrenko/signal-slot Python implementation of Qt-like signal & slot asynchronous programming paradigm with focus on multiprocessing applications
- https://github.com/alex-petrenko/rl-experiments RL algorithms (Double DQN, A2C) for experimental gridworld RL environment called MicroTbs
- https://github.com/alex-petrenko/4dvideo volumetric video recorder and player for Intel RealSense and Google Tango. It can capture and playback "4D" clips like this in real time with a single mobile device. Features a very fast Delaunay triangulation algorithm based on modified Guibas-Stolfi method

ACHIEVEMENTS

- George Bekey Fellow at the University of Southern California (2021)
- Provost PhD Fellowship from the University of Southern California (2018)
- Scholarship of the President of the Russian Federation (2012)
- 1st place at "Osipovsky Cup 2012" programming contest
- Winner of the Code Game Challenge at ACM ICPC NEERC (2012)
- Participant of the ACM ICPC, World Semifinals (NEERC, 2012), multiple prize winner at the ACM ICPC, World Quarterfinals (NEERC Southern Subregional, 2010-2012)

OTHER INTERESTS

- Futurology, transhumanism, singularity. Authors: G. Egan, R. Kurzweil, K. Eric Drexler, V. Vinge, E. Yudkowsky
- Scientific discovery: physics, cosmology, evolutionary biology, human longevity
- Hobbies: motor racing, go-karting, travel, diving, chess