ALEKSEI PETRENKO

petrenko@usc.edu, Los Angeles, +1 (323) 961-17-12
https://alex-petrenko.github.io
https://github.com/alex-petrenko

EDUCATION & RESEARCH

2018-present, USA:

Computer science Ph.D. student at University of Southern California, funded by USC Provost Fellowship (current GPA 4.0/4.0)
Advisor: Prof. Gaurav Sukhatme, USC Robotic Embedded Systems Lab

Research interests: deep reinforcement learning, systems for machine learning, high-throughput and large-scale RL, distributed RL, multi-agent learning and self-play, intrinsic motivation & exploration.
Recent coursework: reinforcement learning, statistical machine learning, advanced analysis of algorithms, advanced natural language processing.

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

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

Programming languages:

- C++ (highly advanced). C++ is my favorite language for its speed, portability, and weird elegance. C++11/14/17, STL, Qt, CMake.
- Python (advanced). Research, prototyping and automation
- C#, Java, Javascript (extensive experience in industry, proficient with some catching up)

Skills:

- Software development and architecture. Creating complex software systems from ground up: mobile, desktop, server-side, VR, plugins, frameworks. Multithreading, optimization, APIs, UIs, etc.
- Deep learning: DL in computer vision, model architectures, geometric deep learning, variational inference, generative models. Deep reinforcement learning. Implemented and deployed many RL methods from scratch: DQN, A2C, PPO, IMPALA, async RL, distributed RL, etc.
  Frameworks & tools: PyTorch, Tensorflow, Ray, RLLib, OpenAI Gym, Isaac Gym, etc.
- Algorithms. Solid background from industry and programming competitions. Graph algorithms,

computational complexity, data structures, etc.
- Computer vision, OpenCV, depth sensors & 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 **Summer 2021, Los Angeles, USA**

Worked on applications of GPU-accelerated physics to dexterous manipulation. Reinforcement learning for object grasping and orientation with a 23-DOF robot.

Technologies: Python, PyTorch, Isaac Gym

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

Worked with Vladlen Koltun and ISL 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 **Summer 2019, Santa Clara, USA**

Advised by Vladlen Koltun, worked on a new asynchronous reinforcement learning system that can achieve up to 150000 FPS of training throughput on a single GPU. Using this new framework achieved new SOTA in VizDoom environments, including the challenging multi-agent and self-play scenarios. The 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. My main project with itSeez3D was the AI-based human digitization engine called Avatar SDK.

- Developed a deep learning-based method 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 single photo by the Avatar SDK demo app: 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**

Computer vision startup and for many years a company behind the OpenCV library. At itSeez 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 a cloud backend for the 3D reconstruction pipeline
- Created mobile and desktop 3D scanning applications
- 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+numpy, 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. Responsibilities ranged from R&D to maintenance with emphasis on software architecture and system optimization.
Technologies: C++ and Qt, C#, Java, Javascript, Python, Linux

SELECTED OPEN-SOURCE PROJECTS

- https://github.com/alex-petrenko/sample-factory the fastest (at the time of release) open-source on-policy RL implementation
- https://github.com/alex-petrenko/megaverse the fastest (at the time of release) embodied simulator for AI research
- https://github.com/alex-petrenko/faster-fifo faster alternative to built-in Python multiprocessing.Queue
- https://github.com/alex-petrenko/tf-reinforce Tensorflow implementation of classic policy gradient algorithms for continuous control tasks
- https://github.com/alex-petrenko/rl-experiments deep RL algorithms (Double DQN, A2C) in the context of the gridworld 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, AGI, singularity. Authors: E. Yudkowsky, G. Egan, R. Kurzweil, K. Eric Drexler, V. Vinge
- Fundamental science: physics, cosmology, evolutionary biology
- Entrepreneurship
- Hobbies: motor racing, go-karting, diving