Ivan Puhachov

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Last updated: June 2024

Publications & Projects

- **Generative 2D Graphics with Diffusion** — Work In Progress
  Ivan Puhachov, Thibault Groueix, Noam Aigerman, Mikhail Bessmeltsev — TBA
  TLDR: Using Stable Diffusion to generate expressive geometry-driven animation. Score Distillation Sampling (SDS), attention manipulation, Textual Inversion.
- **Neural Implicit Reduced Fluid Simulation** — Under Review
  Yuanyuan Tao, Ivan Puhachov, Derek Nowrouzezahrai, Paul Kry — TBA
  TLDR: Fluid simulation using latent space of implicit geometric model.
- **Reconstruction of Machine-Made Shapes from Bitmap Sketches** — SIGGRAPH Asia 2023
  Ivan Puhachov, Cedric Martens, Paul G. Kry, Mikhail Bessmeltsev — project page — acm
  TLDR: 3D shape reconstruction from natural sketch by patch-based optimization. Extracting geometric primitives with ML then aligning them to the drawing.
- **Stability-Aware Simplification of Curve Networks** — SIGGRAPH 2022
  William Neveu, Ivan Puhachov, Bernard Thomaszewski, Mikhail Bessmeltsev — project page — acm
  TLDR: design a curve network on a shape by worst-case stability criterion. Simplified mixed-integer semi-definite programming to an efficient greedy algorithm.
- **Keypoint-Driven Line Drawing Vectorization via PolyVector Flow** — SIGGRAPH Asia 2021
  Ivan Puhachov, William Neveu, Edward Chien, Mikhail Bessmeltsev — project page — acm
  TLDR: novel PolyVector flow aligns curve to a smooth cross-field over bitmap image. ML keypoint detection and optimization to extract vector curves from raster data.
- Demo Projects — personal webpage
  - Trained GAN to generate vector images using differentiable rasterizer — link
  - RNN with attention to draw and complete doodles, trained on Quick Draw data — link
  - 2D shape analysis; discrete geometry and PDE solver; functional mappings; boundary elements method (BEM) for 2d deformation
  - Blender scriptint for generative art; VAE embeddings, clustering and dimensionality reduction for visual storytelling

Experience

- **Research Engineering Intern** at Huawei, Canada — Montreal, Canada
  Oct 2021 - Feb 2024
  - First-author publication in SIGGRAPH Asia 2023
  - Participated in fluid simulation project [under review]
  - Developed product demo for mesh deformation, skinning and rigging, machine learning for shape deformation.
- **Machine Learning Research Intern** at MobiDev — Kharkiv, Ukraine
  Computer Vision user verification; fine-tuning verification system; QA pipeline — Feb 2019 - Aug 2019

Skills Summary

Programming Languages: Python, C++, bash
Frameworks: PyTorch, JAX, NumPy, SciPy, CGAL, libigl, Eigen, pyomo, Ipopt,
Tools: git, docker, Blender, Blender scripting, Adobe Illustrator scripting
Geometry and Graphics: differential geometry; shape analysis; mesh optimization; deformation and animation; vector fields; optimization algorithms
Machine Learning: data processing; clustering; computer vision – detection, classification, segmentation; feature extraction and fine-tuning; generative models – GAN, VAE; neural implicit models – deepSDF, NeRF;

Education

- Université de Montréal — Montreal, Canada
  PhD student in Computer Science, DIRO, LIGUM — Sept 2019 - 2025 (expected)
  Research supervisor: Mikhail Bessmeltsev
- University of L'Aquila & Kharkiv National University — L'Aquila, Italy
  MSc (cum laude) in Mathematical Engineering; GPA: 3.93 / 4.0 — Sept 2017 - June 2019
  Joint MSc Programme Intermaths **Thesis:** "Catacaustics of surfaces" (advisor: Alexander L. Yampolsky)
- V.N. Karazin Kharkiv National University — Kharkiv, Ukraine
  BSc in Mathematics, School of Mathematics and Informatics, Geometry; GPA 3.66 / 4.0 — Sept 2013 - June 2017