

**SAYANTAN DATTA**

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**Research Interests**

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My research interest involves adapting various offline rendering techniques for real time use. While current generation GPUs have hardware ray tracing capabilities, they are not merely powerful enough for bringing offline quality to real time case. With a limited ray budget, we must choose carefully where to focus our ray samples on. As such, I believe real time soft shadows is one of the area which could benefit from the new hardware capabilities when combined with analytic shading and frequency domain filtering.

**Peer reviewed papers**

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Subspace Neural Physics: Fast Data-Driven Interactive Simulation, Symposium of Computer Animation, 2019

**Projects**

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- 2012 - 2016 : Accelerating cryptographic hashes using GPU in John-The-Ripper password security auditing tool.
  - Minimizing instruction count for boolean functions by exploiting hardware specific instructions.
  - Implemented Perfect hash table for detecting hash collisions on GPU.
  - Maintaining GPU kernels for wide range of GPUs taking into account shared memory, register pressure, constant buffer, pipelining (overlap data transfer and compute), GPU temperature.
- 2014 - 2016 : Full stack developer for building Business Application (No longer interested in this track).
  - Worked with databases PL/SQL and JDBC.
  - Server side processing using Java Server Pages and Struts MVC framework.
  - Client side processing using Javascript.
- 2017 - 2018 : Accelerating soft body simulation using latent space dynamics, Ubisoft Montreal.
  - Explored various strategies for compressing the data and time integration in latent space. Tested different Neural network architectures, and evaluated their runtime performance in C++.
  - Worked on integrating C++ Machine Learning inference with Ubisoft production physics engine.
  - Collecting animation data using 3DS max and Ubisoft cloth plugin - used Maxscript and C++.
  - Comparison with other state of the art cloth simulator.
  - Implemented Recurrent Network Architecture in C++.
- 2017 - 2018 : Numerical Study of Frictional Contact, Master's Thesis Project.
  - Our idea was to develop a high quality soft body contact simulator taking into account surface roughness and elastic parameters and use the data obtained to train a regressor, eliminating the need for slow costly computations. Our simulator worked well in 2D case, however 3D results were not entirely convincing, primarily because it is extremely difficult to model accurate and reasonably fast collision detection for surfaces with soft arbitrary geometry in 3D.
  - Theory : Finite element modelling, elasticity theory and damping, modal analysis, collision detection.
  - Practice : Writing high performance SIMD (targeting SSE2 and AVX) code in C++ for VC and gcc compiler, C++ threading, finding workaround for linux kernel bugs, dealing with frustration and more.

## Education

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McGill University	PhD, Elec. and Computer Engg.	Sept 2018 - Present	N/A
McGill University	MSc, Computer Science-Thesis	Sept 2016 - Dec 2018	GPA : 4.0/ 4.0
NIT, Durgapur, India	B.Tech, Electronics and Comm.	July 2009 - July 2013	GPA : 8.91/10

## Skills

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Languages: *C, C++, Java, Python, Javascript.*

APIs: *OpenGL/WebGL, OpenCL, Tensorflow.*

Softwares and Libraries used: *Bullet SDK, Ogre 3D, Numpy, Sklearn, Cuda, Ubuntu, Visual Studio, 3ds Max.*

## Class projects and short projects

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- Reinforced ray-tracing : McGill RL - Implemented a ray-tracer in Nori where the direction of next ray is learnt online using RL. Used C++, Intel TBB for multithreaded updates to the Q-function.
  - Real time rigid body simulation using GPUs : McGill Comp Animation - Implemented Projected Gauss Seidel (CPU) and Projected Jacobi (GPU) solvers for rigid body contacts. Used Ogre3d, Bullet SDK and OpenCL.
  - Ray-tracing engine: McGill Image Synthesis : Implementing BVH, various importance sampling schemes, environment maps, light sources, brdfs, implementation of paper "Linearly Transformed Cosines".
  - Satellite image classification: McGill Theoretical ML - Detecting Crops, Water bodies and Roadways in satellite images using ResNet and Unet architectures.
  - Real time face detection: McGill Image Processing- Used PCA and SVM to detect webcam facial images of 4 people at runtime.
  - McGill Applied ML : Detecting migration pattern of birds and path prediction using RNN, Mixed digit classification using CNN etc.
  - Various raspberry pi projects such as home automation.
  - WebGL welcome screen for my webpage.

## Work experience and internships

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- McGill University, Research Assistant, Jan 2017 - present.
  - Ubisoft Montreal, Animation Programmer Intern - Dec 2017 - Mar 2018.
  - Teaching Assistant - COMP 559 (Computer animation), COMP 250 (Data structures and algorithms), COMP 202 (Introduction to programming), ECSE 222 (Digital logic), ECSE 427 (Operating systems).
  - Damodar Valley Corporation, Assistant Engineer(Instrumentation), September 2013 - August 2016.
  - Google Summer of Code 2013, Project: John The Ripper, June 17 - Sept 27.

## Scholarships

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- McGill MEITA Scholarship recipient.
  - Pierre Arbour Foundation Scholarship(Fall 2017-Winter 2018).

## Volunteer Experience:

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- Selected as a student volunteer at Siggraph Los Angeles 2017.
  - Selected as a Micro Observer to facilitate General Assembly Election on 21st April 2016 in India.
  - Selected as a TA for Coursera Heterogeneous Parallel Programming course, January 2014.
  - Open-source developer for John-The-Ripper password security auditing tool for 3 years.

### Extra coursework (MOOCs):

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- Programming/HPC : Coursera: Heterogeneous Parallel Programming, 2013 and 2014, Coursera: Algorithm Design and Analysis, Coursera: Compilers, Coursera: Hardware Software Interface.
- Math/ML : Coursera : Bayesian method for ML, Udacity : Reinforcement Learning, Youtube : Stephen Boyd Convex Optimization, Coursera: Machine Learning, edX : Intro to Probability and Statistics, MIT 18.02 (Multivariate calculus), MIT 18.06 (Linear Algebra), Youtube : Pavel Grinfeld Tensor Calculus.
- edX: Foundations of Computer Graphics, UC Berkeley.

### Other Achievements:

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- 97.25% Aggregate in Sciences + Mathematics in Senior School Exam, 2009.
- Rank 5th in Indian Junior Mathematics Olympiad 2006.