

JOSEPH CHITTOCK

SENIOR COMPUTER GRAPHICS DEVELOPER



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About Me

I am living in Auckland, working as a Senior Computer Graphics Developer for Soul Machines. I specialise in deformation engineering, real time graphics research & implementations, plugin development, rigging and character pipeline tools.

My active toolset usually consists of Autodesk Maya, Python, Visual Studio, C++, C#, Maya C++ API, Keras, CNTK, PyTorch, LibTorch, Unreal, Unity, HL/GLSL & Open GL.

In my spare time, I have delved into CUDA, cuBLAS, Armadillo, Tensorflow C++ API, Thrust & D3D12.

I have a background in digital & traditional art, mathematics and problem solving, as well as over 7 years of experience in VFX, games and real time applications, working across a variety of technical roles.

I have a deep passion for knowledge, you will often find me spending countless hours researching and imagining new ways of approaching problems. My job is my passion as well as my hobby, it provides me with a creative outlet and keeps me motivated.

One of my favourite quotes is from the great Albert Einstein: - The important thing is not to stop questioning. Curiosity has its own reason for existing.

Languages

- C++
- C#
- Python
- Cuda
- GLSL
- HLSL
- Julia

Attributes

- Quick learner
- Positive attitude
- Proactive self development
- Dedicated
- Friendly & respectful
- Eager to take on challenges
- Appreciative of critique

Skills

- Problem solving
- Applied math & physics
- Machine learning
- Graphics development
- Pipeline development
- Team leadership
- Teaching & educating

Education

- Mount Albert Grammar School (2007 - 2011) NCEA Level 3
- Media Design School (2012 - 2016)

Bachelor of VFX & Animation - Major Computer Graphics

Experience

Senior Computer Graphics Developer Soul Machines (Nov 2021 - Present)

In this role, I have been responsible for the development of visual quality, efficiency, and pipeline of computer graphics at Soul Machines. This development work usually consists of:

- R&D into modern/upcoming real time graphics techniques
- Integration of new techniques into proprietary & 3rd party engines
- Integration of proprietary features into 3rd party engines
- Development of new shading architecture
- Coordination with software engineers on optimisation and feature improvements
- Development & deployment of new asset pipelines and methodologies.

Some examples of the projects I have worked on in this position include:

- Research, implementation and deployment of new shading & lighting architecture in a proprietary engine.

This project was a complete overhaul of the legacy shading architecture in Soul Machines proprietary rendering engine. The aim of this overhaul, was to create an AAA quality collection of shaders, that were fast enough to run a low end hardware, like mobile or VR devices. This was technically challenging, as producing such a high quality result with such a minimal computational budget is difficult. I primarily led this project and utilised several modern lighting, subsurface & refractive techniques, along with several proprietary methods. Our target was to hit a similar visual quality to the unreal metahumans, whilst running at under 9 GPU ms on an AWS workstation. In the end, we believe that we managed to reach a similar, if not higher quality result, whilst running at just over 5 GPU ms, almost 50% under the allotted GPU budget. Within the next 6 months, this new shading architecture is scheduled to be released and available to customers.

Some of the features I developed in the overhaul include:

- Poisson Percentage-Closer Soft Shadows
- Proprietary global illumination solution
- Proprietary subsurface scattering algorithm
- HG phase-function anisotropic scattering
- Tension & Compression mapping (albedo & normal)
- Proprietary refraction solution
- Screen space object blurring (for eye - skin interaction)

- Porting of character library from proprietary engine to 3rd party engines (Unreal & Unity)

This project was worked on by a large group of senior developers and engineers as a move to operating in a more ubiquitous space as a business. Initially, we decided to port our characters to Unreal, as our code base is largely in C++ so it was the logical option. I took a leading role as I had the most experience with Unreal in the group. We rewrote large portions of the codebase to allow a seamless interaction with Unreal and moved on to Unity once we had approval from the Soul Machines executives. I again took a leading position in this part of the project, as I had written a large portion of the code we developed for Unreal. This largely consisted of adjusting the code to the C# syntax, and adjusting some of the logic to match the different dependencies in Unity.

Some parts of this project I worked on include:

- Porting character rigs into engines
- Integrating real time joint quaternion distribution method into Unreal/Unity
- Researching & Developing AAA standard shading networks
- Rewriting, optimising & integrating proprietary facial action coding system in C++
- Developing wardrobe swapping/selection system in C++
- Optimising rendering components to hit performance targets

Character Technical Director Soul Machines (Oct 2018 - Nov 2021)

This role primarily consisted of the development & integration of character related graphics technology, as well as tool development to improve pipeline efficiency. This typically consisted of:

- R&D into new real time graphics techniques, with a focus on character deformation.
- Development of new software & techniques to improve quality and efficiency
- Integration of new methods into proprietary and 3rd party engines
- Research and development into new proprietary deformation techniques.
- Coordination and cooperation with software engineers to improve and develop new features.
- Developing & improving asset pipelines to increase speed and efficiency.

Some examples of the projects I have worked on in this position include:

- Research, development and pipeline development of new deep learning based method for producing facial blendshapes.

This project was first started with the aim of greatly improving the speed and efficiency of blendshapes for Soul Machines characters. My role was to coordinate and provide direction for a group of software engineers, on how to develop & improve their algorithms. I was also tasked with developing several sections of the creation process. These sections essentially took the raw result of the deep learning algorithm, which was messy, and unusable for artists and transform them into a production ready state. Trying to automate this process was extremely difficult, as the goal of completely removing any manual correction was an extremely high bar. I managed to achieve this target by developing the following process in Python and C++.

- Initial asset noise reduction (Maya/Python)
- Proprietary self collision solution (C++)
- Volume based constraint (Maya/Python)
- Eyeball interaction simulation (C++)
- Final cleanup/confirmation process (Maya/Python)

After running through this process, the output would be a clean, production ready result. The final blendshapes were clean, free of any self penetrations or intersections with the characters eyes, and had a natural high-quality facial motion.

- Research and development into a new deep learning based solution to character deformation in real time engines

This research project was created to try to find a scalable, performant alternative to traditional spring based cloth simulation in real time engines. This was an individual project, so I was responsible for researching modern methods and how to implement them in real time. Initially, I developed a prototype in C++, which I pulled into Maya. This prototype utilized TensorFlow to train a deep learning model to predict cloth deformations based on a character's movement. This model was then loaded into C++ through Microsoft's CNTK library and used in real time to predict output deformations. This initial prototype was extremely successful and created film quality cloth simulation in real time.

The next stage consisted of porting this workflow into Unreal. This followed a similar process of loading the model into CNTK, then using Unreal as the input to the predictions, then using the models output as the deformation result. However, implementing this method in Unreal was significantly more difficult, as the engine is not natively designed to accept third party deformation inputs. I developed a method of updating the geometry whilst operating on the CPU, as well as a compute shader method for doing the same of the GPU. Recently Unreal have developed their own implementation of this technique, which operates in a very similar fashion.

- Research and development of several real time simulation methods

This was also an individual project in which I had to research, develop and assess several simulation techniques for real time engine use. These methods included, relative spring based cloth simulation, facial skin simulation and fast newton based tissue simulation. These were all derived from recent research papers in computer graphics, and were integrated into C++ and deployed into Maya for visual assessment. They each gave promising results when assessing speed and visual quality, and the research has been archived for potential implementation in the future if it is needed.

Character Artist/ Rigging TD **Soul Machines (Sept 2017 - Sep 2018)**

This is a generalist type role, Soul Machines had not yet developed specific technical roles for individuals across the company. This meant that most employees would be wearing multiple hats, working across several different areas like character production, tooling & development.

This position typically included:

- Research & development into the latest character production methods
- Producing high quality digital characters in Soul Machines proprietary engine
- Coordinating the implementation of VFX animation techniques in real time
- Rigging & integration of characters for the Soul Machines proprietary engine
- Processing and creating assets through the Soul Machines photogrammetry pipeline
- Updating/modernising legacy shading methods/code

Some projects I worked on in this role include:

- Research and development of new character topology to be used across all characters

This project consisted of compiling research on the latest modern topology solutions for blendable characters, and developing an applicable solution for Soul Machines needs.

- Implementation of Pose-Space deformation into the Soul Machines proprietary engine.

Previous to this project, only joint based solutions were being utilised to produce realistic deformation. My task was to develop and implement a method for utilising Pose-Space deformation in the Soul Machines engine. This consisted of developing several algorithms to produce accurate results.

- Debugging and optimization of legacy shading architecture

This project consisted of rewriting some of Soul Machines legacy shading architecture to fix mathematical errors and improve overall efficiency. I also added some new features/functionality that was requested, some of these included multiple specular lobes and blendshape controlled ambient occlusion.

Senior Technical Director

Huhu Studios (Apr 2017 - Sep 2017)

This role was focused on overseeing technical elements of the VFX process, with a heavy focus on rigging and simulation. I developed several hero character rigs for use in the film Mosley, which was released in October 2019. As a senior, I also helped instruct and develop the skillsets of other staff within the business.

This role usually consisted of:

- Producing high quality hero character rigs
- Implementing cloth & skin simulations
- Providing technical guidance for staff

Creature ATD

Weta Digital (Oct 2016 - Mar 2017)

I was offered this role after placing as a finalist in the Autodesk CG Student Awards in mid 2016. This role was primarily focused on managing, debugging and resolving technical issues with character simulations in the Creatures department. As a developer, I helped build tools and processes to complete this work efficiently. I also received invaluable technical knowledge from industry veterans, who had strong backgrounds in mathematics and computer science.

This role typically consisted of:

- Debugging technical issues
- Developing asset rigs
- Coordinating with senior technical directors
- Building tools to improve efficiency

The films I worked on whilst at Weta Digital are listed below:

- Valerian and the City of a Thousand Planets
- Guardians of the Galaxy Vol.2
- Wonder Woman
- Justice League
- War for the Planet of the Apes
- Altila Battle Angel

Technical Director/Developer

Freelance (Jan 2016 - Sep 2016)

Throughout 2016 I freelanced for several animation studios, providing rigging, shading and simulation services. This typically involved working with a team of talented staff to create unique visual effects for television and AR experiences.

The studios I completed contracts with are listed below:

- Yukfoo (animation studio)
- The Finch Company (advertising studio)
- Flux (animation studio)

I also completed an internship and junior contract role at Sasquatch Productions whilst completing my VFX & animation degree.

Accomplishments

- The Rookies (Autodesk CG Student Awards) 2016 Finalist
- Recognized by Soul Machines as a top performing employee
- Completed courses on C++, machine learning computer graphics

References supplied upon request