## Ryan Kautzman <u>tinymonkey@gmail.com</u> | 415.717.1614

## Epic Games | Senior Physics Engineer | October 2018 - October 2023

- Chaos Flesh Skeletal Muscle System | R&D Collaboration
  - \* Oversaw PBNG (Position-Based Nonlinear Gauss-Seidel) development and UE5 integration
  - \* USD to UE5 GeometryCache with C++ flesh deformer for sim import to ML Deformer
  - \* Houdini GEO to UE5 importer

### • UE 5.2 Rivian Demo | Software Engineer

- \* Real-time tetrahedral FEM sim on Rivian tires
- \* Parallel scene ray cast based environment collisions and collision body paging

### · Chaos Flesh | Project Lead

- \* Real-time tetrahedral mesh finite element simulator
- \* Flesh Deformer implemented in UE5 Anim Deformer Graph and custom HLSL
- \* USD simulation caching system, with custom tetrahedral mesh gprim and value clips support
- \* fTetWild, IsoStuffing, cubic, and cylindrical tetrahedral meshing
- \* Procedurally generated bindings to arbitrary surfaces
- \* World, Component, or Bone simulation space

### · Jiggle Spring Deformer | R&D Collaboration

- \* Real-time closed form ballistic spring deformer, with spring parameters extracted from example ballistic FEM deformation
- \* Unreal ML Deformer and Anim Deformer Graph plugins with custom HLSL shader
- \* Adapted offline higher order math to lower order real-time implementation

### · Facial Simulation | R&D Collaboration

- \* Quasistatic finite element facial muscle system for MetaHuman models
- \* MetaHuman poses as targets for the muscle system
- \* New workflow for building facial models, reducing the amount of time required by about 10X
- \* Improved quasistatic morphing to eliminate tetrahedron inversions
- \* Teeth level set collision geometry from scan data
- \* Adaptive subdivision collision detection for improved collision detection
- \* Visibility/confidence map from captures taken from multiple views
- \* Finite element rest state retargeting
- \* UE5 import plugin for facial sim playback in Unreal

### · Chaos Cloth | Software Engineer

\* Refactored existing Unreal cloth object model to support multiple solvers

### Chaos Destruction Demo | Software Engineer

- \* Vertex decimation via importance ordering for fractured collision bodies
- \* Golden spiral point distributions on analytic shapes
- \* Profiling and optimizations

# Pixar Animation Studios | Senior Software Engineer | December 2005 - October 2018

- · PhysBAM FEM based skeletal muscle simulation for Incredibles 2 | R&D Collaboration
  - \* Stable Neo-Hookean FEM constitutive model
  - \* Quasistatic and ballistic
- · Skin simulators for Finding Dory and Incredibles 2 | Project Lead
  - \* Geodesic and raytracing sliding algorithms
  - \* Procedural constraints and sliding limits
  - \* Analytic inverse Phong projection
- Deformable simulation infrastructure for Finding Dory | Project Lead

- \* Redesign of PhysBAM's deformables, focusing on parallelism and flexibility
- \* Lock free TBB concurrent force evaluation scheduler; CCD, force, and integration loop parallelization
- \* Arbitrary and time independent meshes, bindings, and force topologies
- \* Continual frame relative restaging
- \* On-the-fly re-meshing
- \* C++ JIT plugins
- · Cloth/fluid feather, hair/fluid, and rigid body tentacle prototypes | Special Projects
- USD based sim pipeline | Software Engineer
  - \* Transitioned cloth, hair, flesh, rigid, and vegetation simulators to USD
- · Procedural tetrahedral and triangular meshing pipeline | Project Lead
  - \* Tet mesh construction, refinement, culling, conforming, cutting, and cache coherency optimization
  - \* Multi-layer thin wall tet meshes
  - \* Stochastic and edge collapsing triangle mesh simplification, and hexahedral re-meshing routines
- · AutoPAL: automatic bindings of the PAL scene graph into Presto | Project Lead
  - \* Reduced Presto prim specification from hundreds to thousands of lines of code, to about five to ten
- · MPI distributed fluids for Brave | Project Lead
  - \* Houdini front end controlling PhysBAM PLS, running typically across 64 machines for extended time periods
  - \* Single phase, multi-phase, and viscoelastic
  - \* Comm layer built on custom HTTP server facilitated large data set transfer and distribution, coalescing, and compression, as well as monitoring and control
  - \* Implemented a generalized field API, a 'windowed' source, divergence fields, static and deforming colliders, etc.
- PAL Solids | Software Engineer & Project Lead
  - \* PAL based deformable and rigid body simulator built around PhysBAM
  - \* Designed skin simulator and oversaw implementation
- Physics Abstraction Layer (PAL) | Project Lead
  - \* Light weight scene graph for simulation, built in C++ with python bindings
  - \* Factory based contextual or manual scene construction, automatic multistep data type conversions, temporal and spatial interpolation, data and scene validation, serialization, integrated user documentation, logging, and statistic gathering
  - \* Simulator, front end (Maya, Houdini, Presto, Python, etc.), and execution mode (interactive, realtime, batch, etc.) agnostic
- FEM and rigid body simulators for Wall-e, Up & Toy Story 3 | Software Engineer
  - \* Co-invented rest state retargeting for finite elements
  - \* Articulated and force based angular rigid body constraints
- Kingpin 2 design | Architect
  - \* Requirement spec, design doc, and API spec for python based simulation infrastructure within Marionette
- · Driving system for Wall-e | Software Engineer
  - \* Built a threaded, time budgeted path tracing widget in Marionette for all robots on Wall-e
- Wiggly splines | Software Engineer
  - \* Built a front end for a modal decomposition and subspace deformation experiment with Research

# Industrial Light and Magic | R&D Software Engineer | June 2000 - November 2005

- Deformable simulation infrastructure in Zeno | Software Engineer
  \* Mass-spring cloth and flesh systems
- Caricature flesh development for Van Helsing | Project Lead
  \* Unconditionally stable flesh system developed with Prof. Ron Fedkiw
- · Caricature cloth development | Software Engineer
  - \* Rigid and deforming volumetric collision objects, and geometric repulsion bodies
  - \* Integrated Bridson style continuous collision detection
  - \* Adaptive subdivision collision detection
  - \* Implemented an adaptive time stepping scheme and CFL conditions

- · Real time previsualization | Project Lead
  - \* On-set previs system built on top of XSI game engine for Director Ang Lee
  - \* Built a camera capture system with a non-linear editor
- Timecard and M-Tools | Software Engineer
  - \* Web based timecard and production tracking system, with a Java & Oracle backend

### Publications

- Robust Skin Simulation in Incredibles 2 | SIGGRAPH 2018, Talks Authors: Ryan Kautzman, Gordon Cameron, Theodore Kim http://tinymonkey.org/publications/Incredibles2\_RobustSkinSimulationInIncredibles2\_SIGGRAPH18.pdf
- Finding Hank: Or How to Sim An Octopus | SIGGRAPH 2016, Talks Authors: Ryan Kautzman, Bill Wise, Meng You, Per Karlsson, Mark Hessler, Audrey Wong http://tinymonkey.org/publications/FindingDory\_FindingHankOrHowToSimAnOctopus\_SIGGRAPH2016.pdf
- Stable, Art-Directable Skin and Flesh Using Biphasic Materials | SIGGRAPH 2012, Talks Authors: Ryan Kautzman, Jiayi Chong, Patrick Coleman http://tinymonkey.org/publications/Brave\_BiphasicSkinAndFlesh\_SIGGRAPH12.pdf
- Simulating the Devolved: Finite Elements on WALL-E | SIGGRAPH 2008, Sketches Authors: Geoffrey Irving, Ryan Kautzman, Gordon Cameron, Jiayi Chong http://tinymonkey.org/publications/Walle\_SimulatingTheDevolved\_SIGGRAPH08.pdf
- Jiggly Bits and Motion Retargeting | SIGGRAPH 2004, Sketches Authors: Ryan Kautzman, Andrea Maiolo, Doug Griffin, Andy Buecker http://tinymonkey.org/publications/VanHelsing\_JigglyBits\_SIGGRAPH04.pdf

### Patents

- US9251618B2 Skin and flesh simulation using finite elements, biphasic materials, and rest state retargeting.
- US8847963B1 Systems and methods for generating skin and volume details for animated characters.
- US8290757B2 Method, system and computer readable media for deforming simulation meshes used in posing animated characters. (Rest state retargeting)
- US20140005994A1 Windowed simulation in fluid flows.

## Education

University of California, Davis

Degree: Bachelor of Science in Computer Science | June 2000

- Major: Computer Science
- Emphasis: Computer Graphics and Scientific Visualization
- Relevant Coursework: ECS175 Computer Graphics, ECS177 Scientific Visualization, ECS178 Geometric Modeling, ECS277 Advanced Visualization, ECS278 Computer-Aided Geometric Design

### Programming Languages & Relevant API's

C/C++, HLSL, Python, SQL, Java, JSP, JavaScript, PHP, HTML, CSS, csh & bash scripting (reluctantly) USD, UE5, PhysBAM (Fedkiw et al, dynamics libraries), STL, Boost, TBB, MPI, and many more...

## Credits

Epic Games: Chaos Destruction Demo (2019), Electric Dreams and the Rivian R1T (2023)

Pixar: Incredibles 2 (2018), Coco (2017), Cars 3 (2017), Finding Dory (2016), The Good Dinosaur (2015), Inside Out (2015), Monsters University (2013), Brave (2012), Cars 2 (2011), Toy Story 3 (2010), Up (2009), WALL-E (2008), Ratatouille (2007)

ILM: Van Helsing (2004), The Hulk (2003), Planet of the Apes (2001), plus lots and lots of uncredited work on Pirates of the Caribbean 1 & 2, The Chronicles of Narnia, The Island, War of the Worlds, Star Wars: Episode III, and Harry Potter 3 & 4.

# Personal Mantras

- A good idea is a good idea no matter where it comes from
- Always give credit where credit is due
- Relentlessly take the high road
- If a job is worth doing, then it's worth doing right

And many others I'm continually trying to imprint on the psyche of my kids...