

# Ryan Goldade

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## Skills Summary

- **Languages:** C++, CUDA / Warp, Python / PyTorch
- **Research:** Physics-based simulation, differentiability, neural emulation
- **Machine learning:** VAEs, autoregression, graph NNs, PINNs-based self-supervision
- **Mathematics:** Vector calculus, linear algebra, Newtonian mechanics, numerical PDEs, optimization

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## Experience

### Meta Reality Labs Research

May 2020 - Present

*Research Scientist*

**Neural-based physics:** designed an efficient, neural-based, physical simulation pipeline for secondary dynamic effects for avatars. This autoregressive MLP model achieved long-run rollout stability with extreme performance (1-2  $\mu$ s) on CPU, essential for compute-limited devices like VR headsets.

**Differentiable simulation:** designed a differentiable simulation framework of an anatomically-inspired human model using finite elements and articulated bones. Integrated into optimization pipelines as a PyTorch layer with a C++ backend and a GPU-based linear solver. Optimizing material parameters and joint locators using photometric losses improved temporal consistency for 4-D body and hand tracking using multiview stereo data (MVS).

**Physics-based Avatar Rigs:** developed a physics-based human avatar with muscle-like active-elastic materials, with parameters optimized from MVS capture data. Demonstrated technology at an internal symposium as a real-time simulated avatar with activation-induced facial expressions and self-interactions such as cheek rubbing.

**Blendshape-based tracking:** created a pipeline to transfer a template rig to match human-subject MVS data through regularized optimization of shape and neutral states. Rig transfer improved 4-D tracking as a strong prior, enabling semantically-meaningful latent-space regularization for expression encoding space. Demonstrated technology to CTO.

**Collaboration:** led Meta-funded research collaboration with ETH Zurich on simulating high-fidelity skin wrinkling under contact, resulting in publication. Supervised four interns, co-supervised six interns.

### SideFX

April 2016 - May 2020

*Simulation Developer (part-time)*

**Fluid simulation features:** designed and implemented features for Houdini's FLIP-based fluid simulator. Implementation was primarily in C++ and involved efficient numerical solvers, parallel programming, and sparse data structures to manage millions of voxels and billions of particles. Several features were tech transfers from Ph.D. research.

**Highlighted features:** surface tension, suction fluid, ocean simulation tools (16.0), narrow-band FLIP (16.5, 17.0, 17.5), air incompressibility (16.5), adaptive pressure projection (18.0), and adaptive viscosity (18.5).

### Weta Digital

June 2018 - July 2018

*Simulation Intern*

**Tech transfer:** Implemented Ph.D. research in Weta's simulation R&D pipeline for underwater effects in Avatar sequels.

### IST Austria

February 2014 - May 2014

*Research Intern*

**Embedded liquid surfaces:** improved simulation performance and quality when embedding high-resolution liquid boundaries in lower-resolution fluid simulations. Published at Eurographics.

### Microsoft

November 2012 - September 2013

*Research Intern*

**Real-time smoke:** designed an efficient smoke simulation using a vortex-particle method with robust GPU-based mesh reconstruction to passively advect smoke clouds in real-time. Won *best poster* at Symposium on Computer Animation.

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## Education

### University of Waterloo

2021

*Ph.D., Computer Science*

**Topics:** fluid simulation, computer graphics, numerical PDEs

**Awards:** Alain Fournier Dissertation Award, Queen Elizabeth II Graduate Scholarship in Science & Technology

### Simon Fraser University

2014

*M.A.Sc., Engineering Science*

### Simon Fraser University

2009

*B.A.Sc., Engineering Science*

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## Publications

Publications at top-tier graphics conferences. See Google Scholar

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## References

Available upon request