Geometry Processing in The Wild

Abstract: Geometric data abounds, but our algorithms for geometry processing are failing. Whether from medical imagery, free-form architecture, self-driving cars, or 3D-printed parts, geometric data is often messy, riddled with “defects” that cause algorithms to crash or behave unpredictably. The traditional philosophy assumes geometry is given with 100% certainty and that algorithms can use whatever discretization is most convenient. As a result, geometric pipelines are leaky patchworks requiring esoteric training and involving many different people. Instead, we adapt fundamental mathematics to work directly on messy geometric data. As an archetypical example, I will discuss how to generalize the classic formula for determining the inside from the outside of a curve to messy representations of a 3D surface. This work helps keep the geometry processing pipeline flowing, as validated on our large-scale geometry benchmarks. Our long term vision is to replace the current leaky geometry processing pipeline with a robust workflow where processing operates directly on real geometric data found “in the wild”. To do this, we need to rethink how algorithms should gracefully degrade when confronted with imprecision and uncertainty. Our most recent work on differentiable rendering and geometry-based adversarial attacks on image classification demonstrates the potential power of this philosophy.

Bio: Alec Jacobson is an Assistant Professor and Canada Research Chair in the Departments of Computer Science and Mathematics at University of Toronto. Before that he was a post-doctoral researcher at Columbia University working with Prof. Eitan Grinspun. He received a PhD in Computer Science from ETH Zurich advised by Prof. Olga Sorkine-Hornung, and an MA and BA in Computer Science and Mathematics from the Courant Institute of Mathematical Sciences, New York University. His PhD thesis on real-time deformation techniques for 2D and 3D shapes was awarded the ETH Medal and the Eurographics Best PhD award. Leveraging ideas from differential geometry and finite-element analysis, his work in geometry processing improves exposure of geometric quantities, while his novel user interfaces reduce human effort and increase exploration. He has published several papers in the proceedings of SIGGRAPH. He leads development of the widely used geometry processing library, libigl, winner of the 2015 SGP software award. In 2017, he received the Eurographics Young Researcher Award.

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