

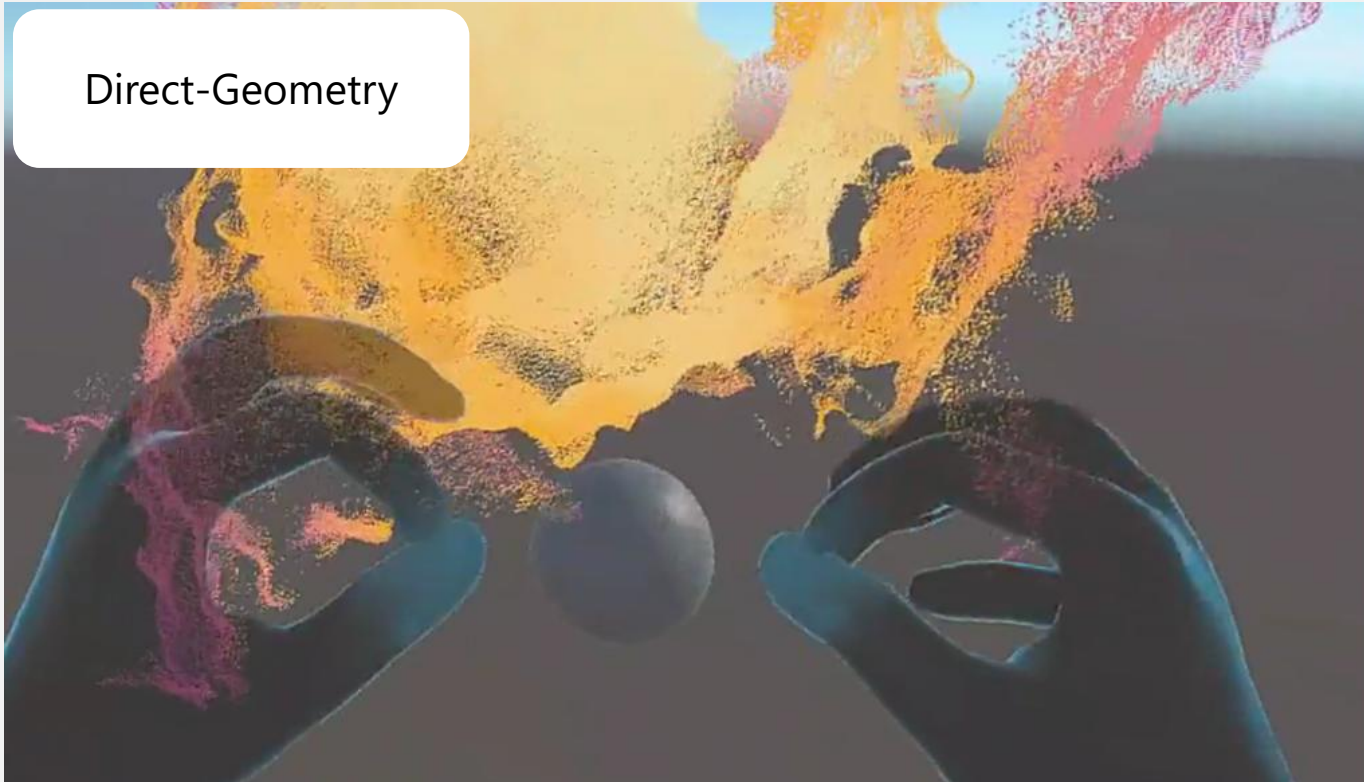
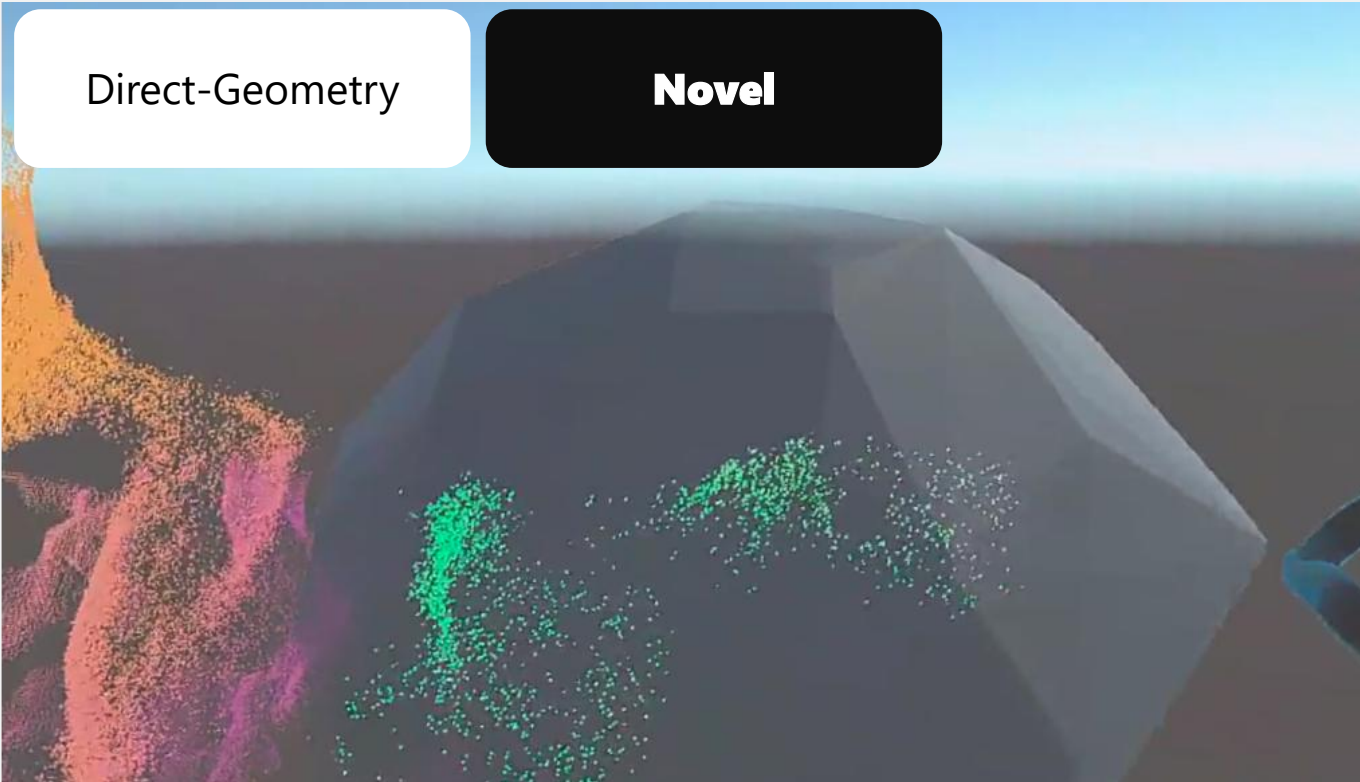
Hand-Drawn Selection Volumes for 3D Point Clouds: Real-Time SDFs Meet Natural Interaction

3D Selection through Hand Tracking in XR for Point Clouds Using Signed Distance Fields

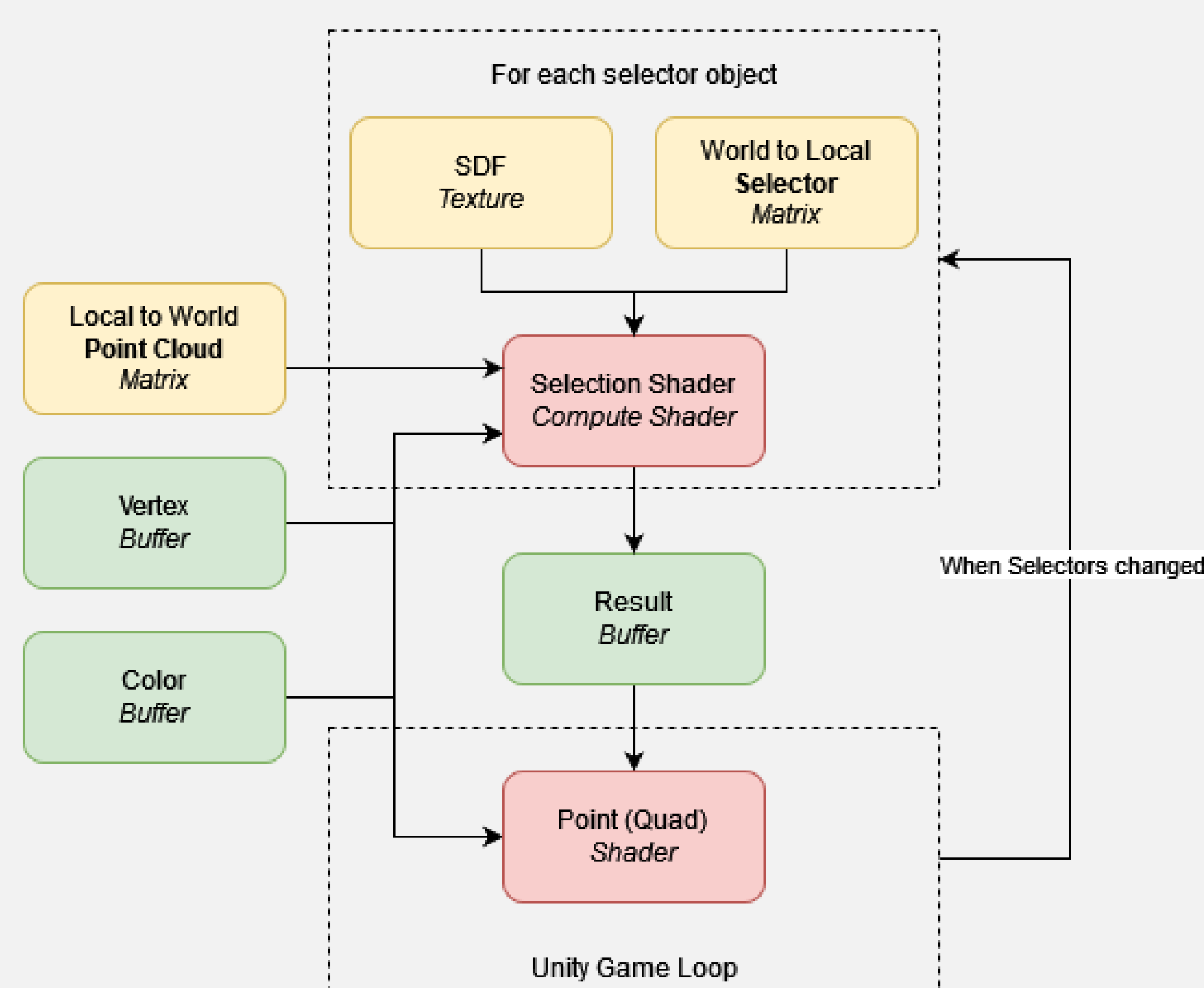
Research Gap

- **Primitive Limitations:** Current 3D selection restricted to basic shapes (spheres, boxes, cylinders)
- **Performance Bottlenecks:** Computational limitations unsuitable for real-time XR applications
- **Interface Constraints:** Traditional approaches confined to 2D interfaces
- **Mental Translation:** Users must mentally map between 2D projections and 3D relationships

Selection Techniques

			
Shapes: Predefined geometric shapes through pinch & pull.	Convex Hull: Mid-air pinch drawing to create convex hull volume.	Brush Sphere: Dynamic sphere-based brushing.	Brush Hands: Utilizes hand mesh and real-time SDFs.

Prototype



- 1 SDFs:** Arbitrary selection volumes through on-the-fly generated SDFs
- 2 GPU Compute Shader:** Parallel point-in-volume testing
- 3 Memory:** All point cloud data (positions, colors, selection states) stay on the GPU
- 4 Unity:** Instanced Rendering, XR Hands, Gestures (Pinch, Pull, Sweep, Handlebar)

Future Work

Current limitations include restrictions to convex shapes in the Convex Hull technique, performance degradation beyond 10 million points, and dependence on variable hand-tracking accuracy across devices. Therefore, future work should include hierarchical data structures and Boolean operations between selections.



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- Full abstract
- Demo video

Contact:

- luca.fluri@fhnw.ch
- arzu.coltekin@fhnw.ch

Fluri Luca, Çöltekin Arzu



University of Applied Sciences and Arts Northwestern Switzerland
School of Computer Science
Institute of Interactive Technologies IIT