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Department of Computer Science

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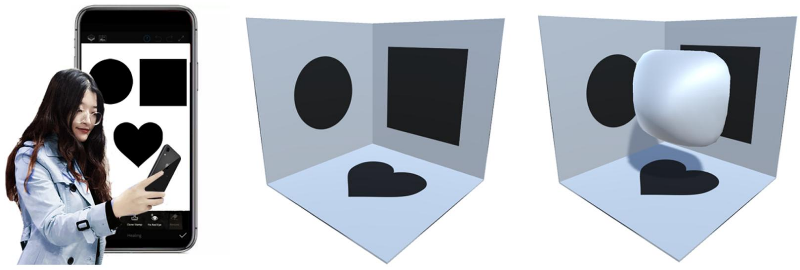
I received my Ph.D. degree from the Department of Computer Science at George Mason University I used to work in the Design Computing and eXtended Reality (DCXR) Lab with Prof. Lap-Fai (Craig) Yu. I received an MS. (Master's of Science) in Computer Science major from the University of Central Florida and a BE (Bachelor of Engineer) in computer science and technology major from the Harbin Institute of Technology(HIT).

Research Interests. My research interests include Computer Graphics (CG), Virtual Reality (VR), Augmented Reality (AR), Augmented Virtuality (AV), Edutainment & e-Training, Procedural Modeling, Computational Design, Deep Learning (DL), Sketch-Based Interface (SBI), Brain-Computer Interface (BCI). Here is my Portfolio. Besides enjoying computer programming, I am also interested in oil painting, piano music composing and cello.

Multi-View NURBS Volume

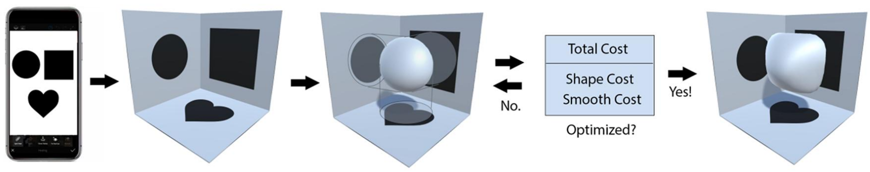


(a) User's input from device. (b) Visualization of user's input. (c) Optimized volumetric NURBS.

Figure 1: Demo of multi-view volumetric NURBS design. (a) Given the user's digital painting of shapes projected from three view directions including the front, top, and left view, (b) The User's three-view design is visualized on three walls in the Unity3D interface. (c) Finally, we optimize the NURBS volume to match with such a design from the three view directions.

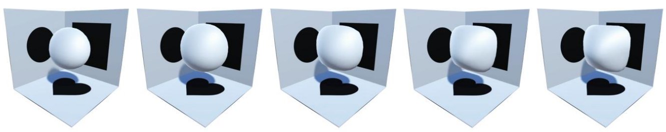
Keywords: Geometric Modeling, Interactive Interface, Numerical Optimization, NURBS Volume.

Abstract: Non-Uniform Rational B-Spline (NURBS) curves and surfaces are widely used in modern geometric modeling systems. NURBS volumes, also called volumetric NURBS, are one powerful NURBS representation of volumetric modeling. However, due to the complex nature of NURBS volumes, it is a challenging task for users to fine-tune the NURBS volumes design manually. In this paper, we present a novel approach for multi-view NURBS volume geometric modeling. Given users' conceptual design for several different views of a 3D model, we devise an optimization algorithm to automatically reconstruct the 3D NURBS volume which is matching with these designs by projecting it along with different view directions. In the end, we discuss the results generated with our approach through a series of numerical experiments.



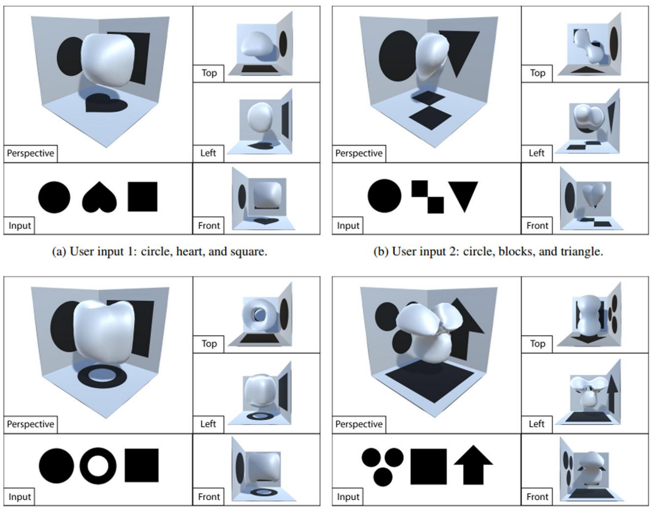
(a) Input. (b) Multi-views shapes. (c) Multi-views evaluation. (d) Optimization process. (e) Optimized result.

Figure 2: Overview ot our approach.



(a) 5^{th} iteration. (b) 10^{th} iteration. (c) 20^{th} iteration. (d) 50^{th} iteration. (e) 100^{th} iteration.

Figure 3: Optimization process. Black shapes which are mapped onto the 3D walls are designed by the user. Figure (a-d) shows the intermediate results generated through the optimization process. During the process, as the cost values are decreasing, the isosurface of the NURBS volume is improving progressively to match with the user's design. Figure (e) shows the result of the finally optimized NURBS volume. As we can see, the result is similar to the user's input.



(a) User input 1: circle, heart, and square. (b) User input 2: circle, blocks, and triangle.

(c) User input 3: circle, ring, and square. (d) User input 4: dots, square, and arrow.

Figure 4: Experimental results of multi-view volumetric NURBS generated with different user inputs. In this figure, we present the visual effects when applying different types of user input of shapes that are defined for different view directions. In subfigure (a-d), they present four different volumetric NURBS isosurfaces generated with our proposed optimization approach according to four different user inputs. As we can see, most results can match the input shapes on different views accordingly.

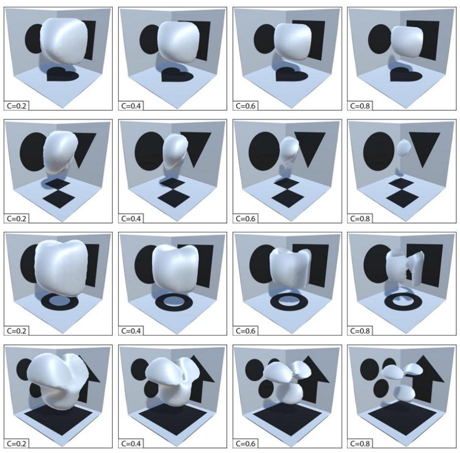
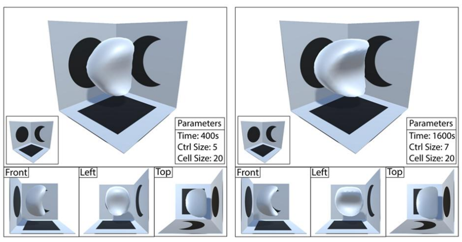


Figure 5: Experimental results of changing isovalues. In this figure, we present the visual effects of applying different isovalues when extracting isosurfaces on the same optimized NURBS volumes. Four different rows present four different volumetric NURBS optimized from the four user inputs specified in Figure 4 with the parameters settings claimed earlier. Four different columns demonstrate four different isosurfaces for each NURBS volume given four isovalues settings, they are C =0.2, 0.4, 0.6, and 0.8 respectively. As we can see there is a trend that as the isovalue C grows higher, the shape of isosurfaces shrinks. Therefore, we need to find a balance point to best describe the optimized NURBS volume. According to the empirical experiences, typically $C \in [4.5, 5.5]$ results in better visual effects.



(a) Lower control precision. (b) Higher control precision.

Figure 6: Experimental results of improving control precision. This figure shows a comparison result between (a) lower control precision and (b) higher control precision. In (a) the control size is $m = n = l = 5$ while in (b) the control size is $m = n = l = 7$. Both result isosurfaces are extracted with the same cell size $20 \times 20 \times 20$ and same isovalue $C = 0.5$. As we can see there are differences in the detail of the shape between different levels of precision control. In (b) with higher control degrees, the shape of the moon in the front view matches better than (a) which is generated with lower control degrees.