Rapid Design of Articulated Objects: An Interactive Showcase

Joon Hyub Lee
Dept. of Industrial Design, KAIST
Republic of Korea
joonhyub.lee@kaist.ac.kr

Hanbit Kim
Dept. of Industrial Design, KAIST
Republic of Korea
hanbit.kim@kaist.ac.kr

Seok-Hyung Bae
Dept. of Industrial Design, KAIST
Republic of Korea
seokhyung.bae@kaist.ac.kr

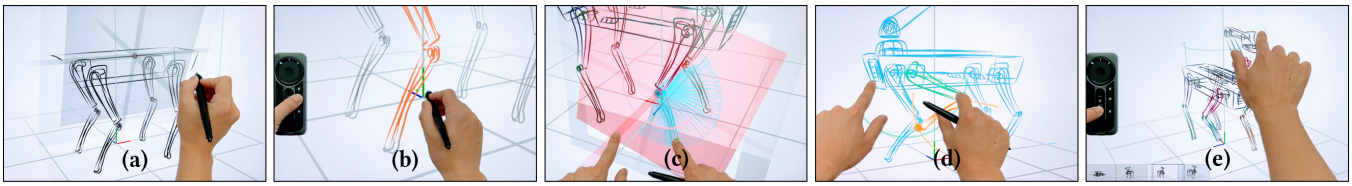

Figure 1: We present a novel 3D sketching system for rapidly designing articulated 3D concepts with a small set of coherent pen and multi-touch gestures. (a) *Sketching*: A 3D sketch curve is created by marking a pen stroke that is projected onto a sketch plane widget. (b) *Segmenting*: Entire or partial sketch curves are added to separate parts that serve as links in the kinematic chain. (c) *Rigging*: Repeatedly demonstrating the desired motion of a part leaves behind a trail, from which the system infers a joint. (d) *Posing*: Desired poses can be achieved through actuating joints via forward or inverse kinematics. (e) *Filming*: A sequence of keyframes specifying desired poses and viewpoints is connected as a smooth motion.

ABSTRACT

Designing articulated objects is challenging because, unlike with static objects, it requires complex decisions regarding the form, parts, rig, poses, and motion. We showcase a novel 3D sketching system for authoring concepts of articulated objects during the early stages of design, when such decisions are made. Designers can easily learn and use our system to produce compelling concepts rapidly, demonstrating that 3D sketching can bridge the gap between 2D sketching and 3D modeling, and be extended to designing articulated objects in films, animations, games, and products.

ACM Reference Format:
Joon Hyub Lee, Hanbit Kim, and Seok-Hyung Bae. 2022. Rapid Design of Articulated Objects: An Interactive Showcase. In *Special Interest Group on Computer Graphics and Interactive Techniques Conference Emerging Technologies (SIGGRAPH '22 Emerging Technologies), August 07-11, 2022*. ACM, New York, NY, USA, 1 page. https://doi.org/10.1145/3532721.3545165

1 BACKGROUND

In recent movies and games, articulated objects often steal the spotlight: a foldable drone that a hero in danger takes out of his pocket, an agile robot animal that roams over rough terrain, a futuristic car that rearranges its parts depending on the driving mode, and a multirole spaceship that transforms when engaging in battle or docking at a station. Many of these may even come into existence, thanks to impressive progress in technology.

However, it is highly difficult to design such articulated objects because they must look good and function well not only in one state but also in all the others, and the transitions between the various states should be appealing and coordinated. Meeting these goals requires complex decisions regarding the form, parts, rig, poses, and motions, each of which affects all the others.

Designers make most of these decisions during the early stages of design through repeated trial and error. However, existing CAD software is not the right tool for rapidly generating and discarding rough concepts because it requires them to construct articulated models with surfaces and volumes elaborately. Moreover, they must do so with a user interface that is best suited for precise fine-tuning at the later stages. Therefore, considerable time and effort is expended on initially unnecessary work.

2 INTERACTIVE SHOWCASE

In this interactive showcase, we present a novel 3D sketching system detailed in our full paper [Lee et al. 2022] as a lightweight alternative to the existing tools. With it, a designer can perform sketching, segmenting, rigging, posing, and filming (Figure 1) to produce a fully animated 3D sketch of an articulated object comprising hinge joints, linear and curved sliders, and ball joints. The result can be exported in a video file format (e.g., MP4) for reviewing or a model file format (e.g., FBX) to be consumed by existing CAD software as a reference in later stages of design.

An expert designer is invited to showcase our system implemented with Unity and running on a Wacom Cintiq Pro 24 Touch tablet. By doing so, the designer demonstrates that our system's small set of coherent pen and multi-touch gestures motivated by bimanual interactions with physical objects is not only easy to learn but also facilitates a satisfying back and forth workflow in which designers can rapidly author compelling concepts of articulated objects suitable for early-stage design decisions in films, animations, games, and products, requiring much less time than existing tools.

REFERENCES

Joon Hyub Lee, Hanbit Kim, and Seok-Hyung Bae. 2022. Rapid design of articulated objects. *ACM Trans. Graph.* 41, 4, Article 89 (Jul 2022), 8 pages. https://doi.org/10.1145/3528223.3530092

SIGGRAPH '22 Emerging Technologies, August 07-11, 2022, Vancouver, BC, Canada

ACM ISBN 978-1-4503-9363-8/22/08.
https://doi.org/10.1145/3532721.3545165