Digital Creations from an Engineering Class in Animation: the Good, the Bad, and the Ugly

D.K. Lieu
Department of Mechanical Engineering
University of California, Berkeley

Abstract

Animation can be an extremely effective and efficient means for communicating engineering information to both technical and non-technical audiences. This paper and presentation will showcase examples of animations that are highly effective, and those that are less effective. Selected animations will be dissected to examine what makes them particularly effective or non-effective. These examples have been extracted from student final projects in a technical animation class at UC Berkeley over a 20 year period.

Introduction

Digital animation tools are readily available today, and even come as a part of most commercial solid modeling software. In engineering applications, these tools allow users to create animations that demonstrate the assembly and/or operation of a mechanical device. Thus, animation has evolved into a highly desirable means for the presentation of technical information. Lieu (2004) offered some simple rules for creating effective technical animations. As compared to drawings, still images, or verbal descriptions, animations that are done well offer unparalleled clarity in the explanation of assembly and operation of devices to both technical and non-technical audiences. However, without consideration for factors such as presentation pace, colors, materials, correct assembly sequences, and representation of important physical phenomena, animations may create more confusion than clarity (Lau and Lieu, 2009).

Examples of successful and also less-than-successful animations can be seen in excerpts from student projects in an engineering animation class that has been taught at UC Berkeley for the past 20 years. The description of the semester-long project for this class has changed only modestly since the course was conceived. This paper presents examples of animation sequences that were done particularly well, and also examples of sequences that were not effective.

Class and Project Descriptions

The first half of the class is advanced solids, and it is the second exposure this material for most of the students in the class. A variety of different solids modeling commercial software has been used in this class since its inception. The semester-long project is to create an animation of the assembly and operation of a moderately complex mechanical device. The animation software is 3D Studio, based on its comprehensive features when compared to the animation features built into most solids modelers. For nearly all the projects, the solids modeler was used to create the part geometries, which were then imported into Autodesk 3D Studio for rendering and animation. Students choose the device to be modeled, however it must be approved by the instructor. The device must be composed of several mechanical components, and be constructed of different materials or material finishes. Additionally, the animation must specifically illustrate the principles of operation and aspects of the device's operation that are difficult to visualize or understand conceptually. Examples include temperature, airflow, magnetic field, fluid flow, and microscopic material properties. The projects are done in groups of three or four students, and are graded on the following criteria:

- Effective use of solid and surface modeling to present mechanical objects.
- Effective use of rendering techniques to emphasize depth and dimension.
- Effective use of colors and surface properties to represent materials and surface qualities.
- Effective use of lighting to present the device and to highlight its key features.
- Effective use of animation to present the assembly and operation of the device.
- Effective presentation of visually and conceptually difficult aspects of the device.
- Effective use of camera motion to view the device from different viewpoints.
- Overall organization and clarity of the animation.
- Overall quality of the animation and graphics.
- Effective use of the soundtrack and music.
- Purposed creativity in the presentation and animation.

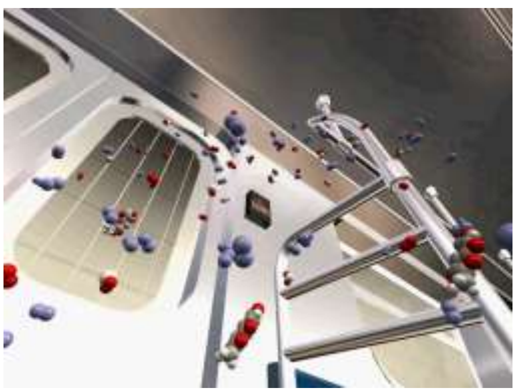
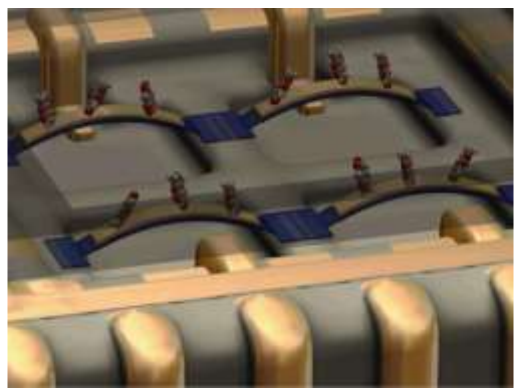
Well-done Sequences

The following excerpts are examples of sequences that were done particularly well. In most of these cases, proper animation technique or creative presentation added information that would have otherwise been difficult understand.

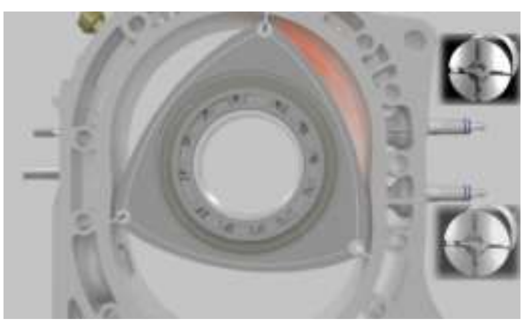
- **Bumblebee transformer** (toy) – Camera motion, part motion and sound are used effectively to emphasize the size and weight of the device, as well as the geometry and articulation of the assembly joints. With over 19 million hits on YouTube, this animation has a particularly high entertainment value.

- **DSLR Camera** – The materials and decals in this animation were particularly well-done, adding to the realism of the presentation. The representation of optical function in the lenses demonstrates a function that would otherwise be difficult to visualize.

- **Digital Nose** – The representation of molecules and molecular motion demonstrates a function that would otherwise be difficult to visualize.

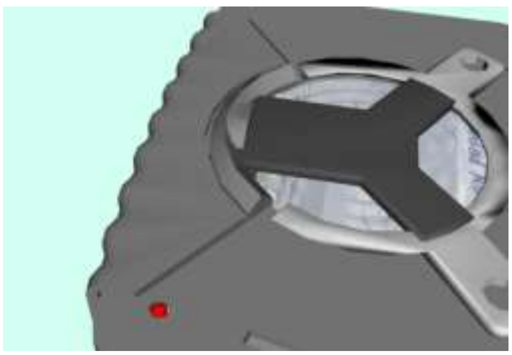
- **Rotary Engine** – representation of the combustion process demonstrates a function that would otherwise be difficult to visualize.




Non-Effective Sequences

The following excerpts are examples of sequences that were not particularly effective, and distracted from the overall quality of the presentation or even added confusion to the presentation. Most of these errors could have been avoided with some simple corrections.

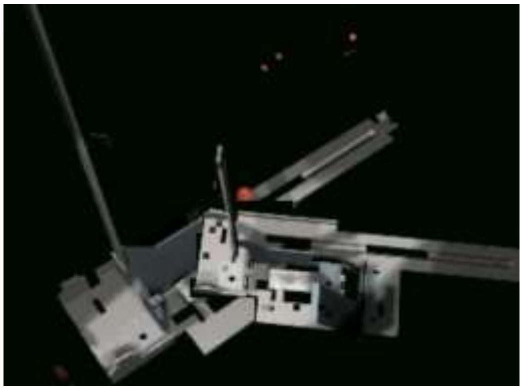
- **Walkman** – Although the timing of the lights to the soundtrack is superb in this animation, poor resolution of the curved surfaces and holes are a severe distraction. This problem could have been easily avoided with careful attention to resolution of surface models at the time they were exported from the solids modeler.



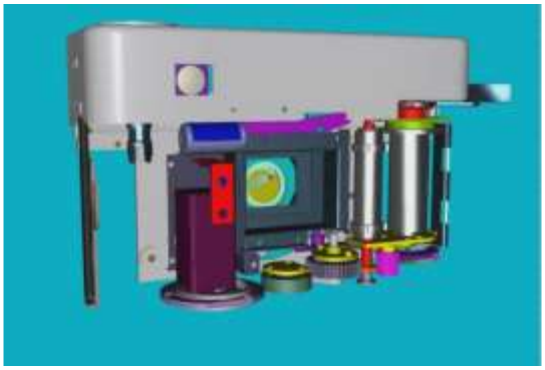

- **Pocket Watch** – Good presentation of material maps and the assembly sequence is done well. However, the presentation of how the device works is essentially non-existent.


- **Toaster** – Poor choices for the background color, lighting, and the part material maps make the parts very difficult to see. The abrupt transitions between animation sequences are very distracting. It is rather obvious that the entire animation was created from pieces made by different people. The presentation of how the device works is essentially non-existent.

This animation was also rendered at a relatively low resolution. The combination of these deficiencies makes it obvious that the team was running out of time to finish the project.



- **Film Camera** – The pace of the animation is far too fast to follow. The materials also appeared unrealistic, and the assembly sequence leaves too many unanswered questions about how the parts fit together.



- **Dancing Santa** – This animation starts abruptly in the middle of an assembly sequence , and ends abruptly after the frame shown below without demonstrating the operation of the device, as required for the project. It is very apparent that this team simply ran out of time before the project was due.

Conclusions

Technical animations can be highly effective in communicating information about device assembly and operation, even if such operation involved physical process that are difficult or impossible to see. If engineers, instead of artists or technicians, are permitted to create the animations, errors in proper depiction of parts, processes, and operations will be reduced. Effective technical animation requires attention to a simple set of rules. Adhesion to these rules can create animations that are not only informative but also a pleasure to watch. Departure from these rules can result in animations that raise more question than are answered.

References

K. Lau and D.K. Lieu, "Effective Use of Animation for Technical Communication," Proc. of the 64th ASEE/EDGD Midyear Conference, Erie, PA, Oct. 2009.

D.K. Lieu, "Animation as a Technical Presentation Tool," Proc. of the 2003 Engineering Design Graphics Mid-Year Conference, Scottsdale, AZ, also ASEE Engineering Design Graphics Journal, Vol. 68, No. 1, 2004, pp. 37-42.