AniVision

New Technology-Assisted Approach to Studying Animation History

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Abstract

The digital humanities project *AniVision* uses machine learning and computer vision to explore a large corpus of animation in ephemeral films produced in Austria, East Germany, and West Germany during the Cold War. Ephemeral films are a diverse group of films produced for specific utilitarian purposes. While there is animation in these films, it has been comparably neglected in animation studies. In recent decades, technological advances have created opportunities to improve this situation. In *AniVision*, a machine learning-based approach is developed to automatically classify animated material within a large corpus of ephemeral films. A collaboration between animation scholars and computer scientists, the project aims to study a previously understudied corpus and to develop methods suitable for the analysis of other similarly structured corpora. This paper provides an overview of ephemeral film and its relationship to animation, before introducing the *AniVision* project and presenting some of its results.

CCS Concepts

•Applied computing ~ Arts and humanities ~ Media arts •Computing methodologies ~ Artificial intelligence ~ Computer vision ~ Computer vision tasks ~ Visual content-based indexing and retrieval •Computing methodologies ~ Machine learning ~ Learning paradigms ~ Supervised learning ~ Supervised learning by classification

Keywords

Animation, Computer Vision, Ephemeral Film, Useful Cinema, Utility Film, Machine Learning

1 Introduction

Until now, research on the history of animation has "focused overwhelmingly on its historical role in art and entertainment" [7, p. 197], with less interest paid to so-called ephemeral film [24, p. 51], one of several terms used to describe a large group of films produced for specific utilitarian purposes that includes advertisements, educational films, corporate films, newsreels, amateur films, and public service announcements. Within these films there is widespread integration of animation [7, p. 197], ranging from basic formal-functional elements like titles and credits to complex sequences.

One possible reason for this lack of interest may be the difficulty of studying animation in such a vast and often poorly documented area of film production. Because of its comparably high production costs, the use of animation in ephemeral films tends to be selective, making brief sequences embedded in live-action material more common than fully animated films. When metadata is created for a film, such sequences are often not considered or recognized as animation. As a result, simply identifying relevant material can become a labor-intensive task for animation scholars wishing to study ephemeral film. To improve this situation, the *AniVision* research project takes advantage of developments in computer vision and machine learning to develop automated content-based visual retrieval methods for animated material.

AniVision is a systematic, large-scale, data-driven analysis of animation styles and their historical development in ephemeral films in Austria, West Germany, and East Germany during the Cold War. It is an interdisciplinary collaboration between computer scientists and animation scholars that follows a distant viewing approach, i.e., "the application of computer vision methods to the computational analysis of digital images" [2, p. 3]. Such methods allow the analysis of larger corpora, which should provide greater insight into stylistic patterns and their evolution in the animation production of the countries considered. However, this first requires the development of computer vision methods tailored to the characteristics of the corpus, e.g. small amounts of different animation techniques embedded in a majority of live-action material. In their design, these methods should be applicable to other similar corpora, allowing more comprehensive histories of animation to be written. This paper will first provide an overview of ephemeral film, its various subgroups and its relationship to animation, before introducing the *AniVision* research project and presenting some of its current results in the form of a short case study.

2 Genre in Ephemeral Film

Much like the term ephemeral film itself, there are many, often overlapping, terms for its subgroups. Most are derived from either a film's institutional origin, i.e., its sponsor, or its utilitarian purpose, i.e., its function. Frequently used sponsor-based terms are corporate film, industrial film, science film, and amateur film. Sometimes used synonymously, the first two terms describe "films commissioned and used as a communication tool by corporations and business associations (excluding advertising spots)" [27, p. 104]. Science films are produced by institution

engaged in scientific research, and amateur films are defined by the fact that they are produced by laypeople; the latter's classification as ephemeral is debatable [24, p. 52–53], as the ephemerality of individual films is highly circumstantial.

Common function-based terms include advertisements, health education film, educational film, training film, work safety film, newsreel, public service announcements, and research film. Advertisements are films produced to promote commercial products, services, or companies. Health education films are "produced with the intention of reforming or reinforcing public health beliefs and practices" [3, p. 1]. Educational films are produced to educate their audience, and training and work safety films are two subgroups of it with more specific educational goals, the former preparing for a defined task and the latter teaching how to avoid workplace accidents. Newsreels are short documentary films shown in movie theaters that cover current events and other miscellaneous topics and set the template for later news formats on television. Public service announcements, usually sponsored by government agencies, are produced to inform the general public. Finally, research films are produced by scientists "in order to document phenomena or processes" [9, p. 90], and differ from educational films in their assumption of an expert audience [9, p. 90].

Both types of classifications have their own advantages and disadvantages. The advantage of sponsor-based classifications is that many organizations sponsoring film production have apparent defining characteristics. The problem is that individual organizations may sponsor a wide variety of films, which reduces the significance of grouping these films together. This is the advantage of function-based classifications, which emphasize how films sponsored by different types of organizations may serve similar functions. The problem with these classifications is that identifying a film's function can be a relatively interpretive task. For this research project, it was decided to include both types in our metadata schema, treating all terms as fuzzy, non-exclusive categories so as not to preemptively impose a restrictive framework on their understanding. Since ephemeral films are never meant to be "self-sufficient entities for aesthetic analysis" [15, p. 11], these categories, which effectively quantify many of the practices surrounding their production and reception, are an important aspect helping to research larger corpora and allow the identification of relationships between the practices they encapsulate and the aesthetic design of individual films.

3 Animation in Ephemeral Film

From its inception, animation as a filmmaking practice has "also appealed to experts working in other professional fields, from science and medicine to education and advertising" [7, p. 197]. As a result, it was quickly used in various types of ephemeral film, with examples from the early twentieth century including Arthur Melbourne-Cooper's stop-motion advertisements [13, p. 30], mathematician Ludwig Münch's educational films [14], and training films made for the U.S. Army by the Bray Studios and Max Fleischer [13, p. 58].

The use of animation in ephemeral films often serves one of several common functions. One is to capture and hold the audience's attention through a distinctive visual presentation. Typical examples of this are advertisements, where the use of animation ranges from appealingly drawn characters to stop-motion techniques animating immobile objects. Another is to "visualize relations and show things that could not be photographed or seen with the naked eye" [7, p. 197], with an obvious example being the use of time manipulation techniques in science films. In the case of drawn animation techniques, this function often goes hand in hand with a third: to create visual as well as intellectual abstractions [12, p. 43]. To this end, animation is used to depict, among other things, medical procedures and biological processes. These functions overlap with the use of animation in entertainment and art, with a particular closeness to animated documentaries, as evidenced by some early studies of the latter including ephemeral film [10]. In addition, these functions also point to seldom considered relationships, such as those between animation and illustrations made in educational and scientific contexts.

To date, there is only a small body of scholarship on animation in ephemeral film that considers these two aspects equally. Examples include the edited collection *Animation and Advertising* [4], monographs on the war efforts of the Disney and Warner Bros. Studios [18], contributions to edited collections [6, 19, 21, 22], and journal articles [7, 17]. Beyond this, most research on the topic comes from either animation studies or scholarship on ephemeral film [7, p. 197] and tends to treat the other aspect in a more rudimentary manner.

In animation studies, ephemeral films are considered in both broader histories of animation and monographs on individual animators or studios. In the former, they are sporadically acknowledged [13, p. 228], but more time is spent on them only when they have historical relevance [13, p. 79] or double as experimental animation [13, p. 87]. In the latter, individual films receive more attention, but because the subjects are usually important animators [8] or studios [18], there tends to be a strong overlap with the ephemeral films considered in broader histories. In all of these, the focus is usually on advertisements, thanks to them having "been central to the work of famous animation studios and celebrated artists" [5, p. 1]. From a different direction, scholarship on animated documentaries [10, 11, 16, 25] provides valuable input for considering animation in ephemeral film, even if most of it is not concerned with ephemeral film per se.

In studies of ephemeral film, the presence of animation is often acknowledged without further elaboration. For example, Rick Prelinger's study of the films of the Jam Handy organization notes their "frequent deployment of animation, including a number of striking stop-motion animation sequences that recall the work of Oskar Fischinger" [20, p. 215], but does not explore this aspect further.

On the level of individual research, this lack of consideration of animation in ephemeral film is often dictated by both subject matter and film access. Collectively, this has resulted in an impoverishment of the documented history of animation. Given

both the often regional nature of ephemeral film production and the frequent use of animation in these films, it is reasonable to assume that even in countries with little documented animation production, there would have been animation production for ephemeral film. Even if these films have been archived, it is still a great challenge for scholars to find them. *AniVision* aims to improve this situation by developing computer vision methods tailored to this task.

4 *AniVision*

For *AniVision*, a corpus of ephemeral films was assembled from material provided by thirteen archives, five Austrian, eight German, including corporate, governmental, and animation-specific archives. At the time of writing, the corpus consists of approximately 2000 digitized film files, of which over 850 are annotated to some degree, for a total running time of over 210 hours of annotated material. Initial assumptions about the presence of animation in this corpus could be confirmed, e.g., that there would be few fully animated films, but many short segments embedded in live-action material. To develop computer vision methods for the automated analysis of animated films, parts of the assembled corpus were manually annotated with a controlled vocabulary. Structured in a hierarchical template, this vocabulary, consisting of defined scholarly concepts, formalized the annotations and ensured their machine readability. This allows them to be used both as quantitative data for scholarly research and as reference data for machine learning.

Once a sufficient number of films had been annotated, the computer scientists began machine learning experiments. Because the initial experiments were based on single frames, and because several animation techniques in the corpus are indistinguishable from live-action without considering motion, an originally planned first step of classifying images as either live-action or animation was replaced by the proxy task of classifying images as either photographic or non-photographic compositions. A model capable of doing this would already be able to distinguish many common animation techniques from live-action. During the experiments, the application of an explainability algorithm made it possible to better utilize the expert knowledge of the animation scholars by improving their ability to evaluate the experiments. The best experiments on this task achieved test set f1 scores close to 95% [1, p. 10], suggesting that a resulting model, especially when combined with other types of visual retrieval, should be able to achieve high accuracy in automatically classifying animated film.

Another task for the computer scientists was to design a database and frontend for uploading annotations and entering metadata. Metadata included the aforementioned genre classifications and, where possible, credits from either the films themselves, available paratexts, or existing databases. Effective access to both metadata and annotations is required to enable large-scale corpus exploration for the purpose of distant viewing. Such a distant viewing can reveal larger developments within the corpus, as well as professional networks of animators and production companies. Caution must always be exercised, however, as the poorly documented and archived status of ephemeral film production limits the representativeness of any assembled corpus. Nevertheless, trends can be observed, especially when focusing on subgroups of the corpora, where representativeness is easier to determine.

5 Case Study: The Institute for Scientific Film

A well-documented subgroup of the *AniVision* corpus are the films of the Institute for Scientific Film (IWF), a major West German producer and distributor of science films. Existing from 1956 to 2010, its founder, Gotthard Wolf, once wrote that "the science film does not strive for illusion, but for the objective reproduction of reality" [1] [26, p. 477]. In light of this, it is particularly interesting to look at how the organization's films have used animation, since its ontological status puts it at odds with typical notions of objective representation.

For *AniVision*, the assembled films were preselected to focus on those that might contain animation, and more than 150 were manually annotated. In total, more than 33 hours received a label indicating a basic image type, with more than 16 hours annotated as animation and about 10 hours as live-action Looking at the temporal distribution of animation in these films, there are noticeable peaks at the beginning and end, reflecting the frequent use of animation for titles and credits. At 8 hours, the largest group of animation are cutouts, followed by 3.5 hours of time manipulation and 3 hours of cel animation.

There are several possible explanations for this distribution of animation techniques. Cutouts can be created from a variety of materials, reused across multiple films, and adapted from existing scientific illustrations with comparable ease, making them a cost-efficient form of animation in this production context. Their drawback, that they, while efficient at depicting the motion of objects fixed in shape, are themselves less malleable, is less problematic in science films, where animated objects are often both visual and intellectual abstractions, their fixed shape sufficient for supporting the audience's understanding of what they signify. Time manipulation being the second largest group reflects animation's continued use to "show things that could not be photographed or seen with the naked eye" [7, p. 197]. Finally, cel animation can fulfill similar functions as cutouts, but can more easily depict objects that change shape, such as growing plants.

Returning to Wolf's statement, the use of both cutout and cel animation may have been legitimized by them being interpreted as a continuation of established scientific visualizations that were perceived as objective representations. Regarding the frequent use of time manipulation, Wolf himself spoke of such filmmaking techniques as a way to overcome the limitations of the human sensory apparatus [26, p. 477]. However, simply mapping Wolf's statement of intent onto broader stylistic patterns does not fully do

[1] "Der wissenschaftliche Film erstrebt nicht die Illusion, sondern die objektive Wiedergabe der Wirklichkeit" (English translation by author). Beyond the general philosophical implications of this statement, it must also be read in the context of the IWF's organizational self-interest. Framing science as an objective, apolitical endeavor supported ignoring the organization's entanglement with the RWU, its predecessor in Nazi Germany [23, p. 280–290].

justice to the IWF corpus. Between the IWF's changing leadership, its collaboration with scientists based elsewhere, and its occasional distribution of films produced by other organizations, preliminary close readings suggest that the corpus includes a broader range of ideas about what constitutes acceptable use of animation in science films.

At this point, the findings on the IWF corpus confirm some basic assumptions about the role and presence of animation in ephemeral film. The dominance of several animation techniques may be linked to the intended utilitarian function of these science films, while their appearance also suggests how production contexts, in this case the IWF's own history and understanding of its role as part of a scientific community, influence aesthetic choices. The amount of animation present in this corpus, a corpus not usually perceived as an important site of animation production, suggests the sheer volume of existing animation whose obscure position has so far stifled attempts to study it.

6 Conclusion

The *AniVision* research project is an interdisciplinary analysis of a large corpus of ephemeral film. By using computer vision to explore a previously understudied corpus, it contributes to both computer science and animation studies. While recent years have seen strong developments in computer vision, its application to animation remains comparatively niche. The results of the project's initial machine learning experiments suggest that the goal of automatic analysis methods tailored to animation is feasible. The need for such models arises from the existence of large, poorly documented film corpora that are likely to contain animation. In the past, attempts to study animated material within these corpora have been prohibitively expensive due to the amount of work required just to identify it. The proposed model for the automatic classification of animated material will assist in this task, thereby enabling the study of animation to include such understudied corpora. Furthermore, the corpus assembled for this project is itself understudied. Thus, its study contributes to animation studies in its own right, for example by identifying other topics of interest within it, such as previously unknown animators.

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