RASP: A Comprehensive System for Complicated Actions in Halfpipe Sports

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ABSTRACT

Action sequence panorama (ASP) in sports is mostly considered as artistic representation and seldom used to understand actions in sports. Whereas, halfpipe sports are usually composed of complicated actions and audience is hard to understand fast-moving and complex actions while watching videos. One of the characteristics of ASP is to put things in different temporal steps together; therefore, it can be treated as a decomposition of continuous movement. We chose inline (inline-skate) vert (halfpipe) as the target sport of our case study to see if ASP can assist users to understand complicated sports actions. For some inline vert tricks, it is hard to present all the actions details due to scene overlapping issues. To overcome this issue, an effective and natural recomposition method of ASP is proposed. Since our recomposition method is developed based on the way that athletes developing their tricks, the usage of the proposed system is natural and even be unaware to users. Besides, the developed enhancing tools, i.e., the halfpipe model and the action figure we used in user study can also be seen as an assisting learning tool for users, they provide an effective way for both professionals and amateurs to comprehend complicated actions in halfpipe sports.

1. INTRODUCTION

An action sequence panorama (ASP) extracts moving objects from different temporal steps, then stitches and aligns them onto a single panorama. And, in sports, it is considered as an artistic presentation used to appreciate or to entertain. However, an ASP is seldom to be used to understand actions in sports. It has mentioned in that ASP is effective for analyzing sports with a large arena like diving and jumps. Whereas, ASP is hard to be applied to some sports in which moving objects in the panorama are overlapped together; therefore, ASP is seldom to be used to understand actions in sports.

In this study, inline (inline-skate) vert (halfpipe) is chosen as our target complicated action. In order to overcome the pre-described “object-overlapping” issue, in this paper, ASPs recomposition method (denoted as RASP in the rest of this work) is proposed and analyzed. Therefore, we can examine and compare the degrees of human comprehension about complicated sports actions by using ASPs and RASPs.

To evaluate whether ASPs and RASPs is useful for understanding halfpipe sports actions, we set up an evaluation system consists of a video player and ASPs and RASPs generated based on it. The detail of the system will be illustrated in the following sections.

2. ACTION SEQUENCE PANORAMAS
2.1 Characteristics of Action Sequence Panoramas

The main advantage of using an ASP instead of a close-up image is: it is hard for a person to know the orientation and the position of an athlete in a video if a camera captures a large portion of the athlete’s body but a little about the background. In contrast, a person is able to see the whole arena where the moving object passes through by using ASP. When a person wants to understand an action of a halfpipe sports, he/she has to frequently loop the same video segment several times, because one cannot recall every details of the complex actions in an instant visual sensory image. While, by looping the same segment, the relationship among the actions in different temporal steps can be built; in other words, ASP can simplify and assist in our video based action comprehension process. To observe details of actions between different temporal steps, we may want to place more moving objects on the same image, but eventually one object may overlap with other objects if the chosen temporal step is too small. If two objects in different temporal instants overlapped a lot, one may not able to distinguish their respective actions, and the corresponding ASP is useless in this situation, as shown in Figure 1(b). This is the reason why ASP cannot be applied for analyzing halfpipe sports, directly.

2.2 Action Sequence Panorama Recomposition

To overcome the above-mentioned overlapping issues of ASP in halfpipe sports, we rearranged the positions of the observed objects in different temporal instants on the same ASP image in such a way that they are not overlapped, as shown Figure 1(c). By interviewing professional halfpipe athletes of inline skating (inline vert) about the way they developing a tutorial for a new trick, we learned that almost every trick has a slight variation in making a different curve on the halfpipe, as illustrated in Figure 2. And most of the tricks can be performed at a higher position. For example, if the path of a trick is straight up and down, as illustrated in Figure 2(a), in the proposed RASP, we make it wider to become a curve and also make it higher to become a higher and wider path, as illustrated in Figure 2(d).

In this way, we get extra space to place objects in different temporal instants into different and non-overlap positions. Lastly, we removed all shadows of the athletes, because putting objects with different light sources and shadows together are somewhat annoying and lofty in vision.
3. ENHANCING TOOLS

“How do we know whether one understands an action of the athlete?” There are two issues we have encountered. First, users have their own prior experiences of halfpipe sports, such as watching TV broadcasting videos or even getting involved in the sports. They may not use proper nouns in halfpipe sports, and thus the description is ambiguous for us. Second, even if the verbal description in proper nouns sounds correct, it may mismatch with the action actually done by the athlete. This is because some of the halfpipe actions look similar from different viewing angles and users tend to describe the action based on his/her own viewpoint.

In order to make a correct description about a halfpipe action and enhance user’s degree of comprehension of it, we build a halfpipe model and an action figure as assisting tools, as shown in [Figure 3]. Users can describe the actions in non-verbal narratives by using enhancing tools. Moreover, the enhancing tools can stimulate users to think and to respond in a rationale way, and therefore, make a connection between the actions in user’s mind and the actions shown in the video. Interestingly, the tools work in a way similar to human’s mental practice [1], for example, they can simulate how halfpipe athletes to perform tricks in subjective or objective perspectives of view to retain physical strength during a contest.

4. FEATURES OF VIDEO PLAYER

For simplicity, we took off unnecessary features (e.g., the screen-shot) to help users access to it, quickly. The video player has the following features: play, pause, adjust play speed, frame-by-frame play, frame-by-frame reversely play, going to the beginning/end. The frame-by-frame reversely play feature is important when a user want to comprehend the actions in halfpipe sports. She or he can fast switch between the previous and the next video frames to catch the action details. All functions of the video player are operated by using a generic keyboard.

5. USER STUDY

5.1 Objectives

In order to determine whether ASP and/or RASP can facilitate users recognizing athletes actions in a halfpipe sports video, we designed a user study to address the following questions:

Q1: Can ASP or RASP facilitates users memorizing full sequences of a trick performed by an athlete?

Q2: Will a user, often watching both ASP and RASP, notice the athletes in some ASPs have been recomposed to different places in the corresponding RASP?

5.2 Procedure

The backgrounds of the participants were surveyed by questionnaire before the activities. Each participant is asked to complete 2 activities for each of the 7 tricks. Activity 1 is a baseline indicating the level of difficulty of a trick. Activity 2 is used to explore how the participants comprehend the target tricks and what strategies they will take when they cannot understand an action.

In activity 1, restricted video player (with only “play” function on PC) was used, and the participant is asked to view a clip exactly 5 times repeatedly. In activity 2, the video player with full functions and the RASPs (shown in a tablet) were used, participants are asked to view a clip for 3 minutes. And they can switch between tools or use them simultaneously. In each activity, the participants will first watch the athlete’s action. Then, the subjects will be asked to repeat the athlete’s action by using the enhancing tools and thus we can learn to what degree the subject’s comprehension, as shown in [Figure 3]. All the subjects are allowed neither to watch the video nor the RASP during the period of repeating the tricks by the enhancing tools. An assistant will tell the subjects failure or success after completing the task. Besides, the subjects have to leave the video screen when repeating the tricks to avoid step-by-step imitation from the video. In the end, for investigating Q2, the participants will have an interview and will be questioned about “did you find anything unnatural or weird in ASPs?”

5.3 Participants

To conduct our user study, 5 males, aged from the age of 23 to 26 are recruited. All of them have experience in watching sports videos involving spin moves, e.g. front flip. They are able to do forward roll, but without experiences of spin moves. Some of them are able to do cartwheels (1), backward rolls (2), and front handsprings (2).

5.4 Tricks

We employed 7 clips (tricks) performed by 5 athletes with different styles. All clips, except for fakie, are less than 5 seconds. In the activities, we generally arranged the order of clips from ease to difficult ones. These tricks are “fakie”,
“turn”, “720”, “540”, “California roll”, “900”, and “Mctwist” in order. The ASPs of fakie and turn were placed in order, but the others were not. Fakie and turn are of top priority in our arrangement to build mechanisms of tricks for participants because both of them are basic movements and most of further development of tricks must be started from them. So we put them on the front of testing videos. Besides, we consider “turn” as a key clip to let participants accept RASPs. 540, 720, 900 are spin tricks of different degree rotating around the vertical axis of human body. California roll and Mctwist are tricks involving manipulating rotation axis techniques. That is, athletes can change their rotating direction by extending or compressing their parts of their body. In our experience, a user can hardly understand how these tricks are performed even on watching videos by using frame-by-frame play and reversely play features several times in a short period of time. We deliberately let participants fail to comprehend these tricks, and we also set contexts to make them try their best to figure out the tricks actively.

<table>
<thead>
<tr>
<th>Trick Name</th>
<th>Activity</th>
<th>Participant</th>
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<tbody>
<tr>
<td>Fakie</td>
<td>I</td>
<td>P1</td>
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<tr>
<td></td>
<td>II</td>
<td>P2</td>
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<tr>
<td>Turn</td>
<td>I</td>
<td>P3</td>
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<tr>
<td></td>
<td>II</td>
<td>P4</td>
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<tr>
<td>720</td>
<td>I</td>
<td>F</td>
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<td></td>
<td>II</td>
<td>F</td>
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<tr>
<td>540</td>
<td>I</td>
<td>F</td>
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<tr>
<td></td>
<td>II</td>
<td>F</td>
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<tr>
<td>California Roll</td>
<td>I</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>F</td>
</tr>
<tr>
<td>900</td>
<td>I</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>F</td>
</tr>
<tr>
<td>Mctwist</td>
<td>I</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>F</td>
</tr>
</tbody>
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Table 1: The results of each participant in performing every trick in activities 1 and 2. F stands for that the participant failed in the activity, and blank denotes that the participant succeeded.

6. RESULT AND DISCUSSION

Most of the participants (9 out of 10 trails) were failed to understand the spin tricks involving manipulating rotation axis techniques, i.e., California roll and Mctwist in activity 1, but some of them (4 out of 10 trails) were succeed to perform these skills after performing activity 2, as shown in Table 1. We asked each participant that “did you find anything unnatural or weird in ASPs (some are actually RASPs)?” Only 1 out of 5 subjects found that some panoramas have been recomposed. The results overwhelmed our expectation because the participants watched each trick for at least 3 minutes. One of the participants said “I only focused on watching the athletes’ action, and I did not care about the real paths they skated through.”

In the activities, participants chose the video player as their major learning tool, because they can get exact timing of an action and repeatedly view between the previous and the next frames. In this way, participants can comprehend the ticks of 540, 720, and 900 by watching video player only, because the major difference among them comes mainly from the rotation speeds. One participant said “ASPs didn’t proffer me any feeling of moving, and they looked all still.” The illusion of a moving object in the video is an effortless way to understand continuous actions.

However, when users try to comprehend complicated actions especially for those involving manipulation of rotation techniques, ASPs and/or RASPs do help them a lot. After completing activity 2 of California roll, one of the participants said “the ASP (RASP) suddenly become useful. It helps me memorize the actions in two different timing. The more complex an action is, the more helpful ASPs (RASPs) are.” Besides, with the aid of ASP (RASP) a user can view the whole halfpipe area to locate the body position and orientation of an athlete.

7. CONCLUSION

ASP is considered as an artistic representation, but our user study shows that it is also effective in comprehension actions in halfpipe sports. Watching videos is an effortless way to understand actions. However, when users cannot realize a complicated action by watching video only, ASPs (RASPs) are particularly useful. We proposed a recomposition method for ASP which resolving the overlapping issues in usual ASP. Since the proposed recomposition method is based on the way that athletes developing their tricks, its usage is natural and the developed enhancing tools provide an effective way for both professionals and amateurs to comprehend complicated actions in halfpipe sports.

8. REFERENCES