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Title	**EE: Evaluation of step-in/step-out capability of state-of-the-art view synthesis technology**
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1. Introduction

During the last meeting in Hobart, a set of Exploration experiments within the scope of MPEG-I , related to Windowed 6-DoF use cases [1], have been defined. This document reports results for "Exploration Experiment 2: Evaluation of view synthesis/rendering software" which aimed at evaluation capability of stepping-in and stepping-out of the scene.

2. Experiment setup

The general setup of experiment has been presented in Figure 1. The experiment started from a set of views arranged on an arc (light and dark blue cameras). From those views we have selected two views (dark blue camera) accompanied with depth data. Based of those selected views, we have rendered a set of virtual views (green cameras), positioned in-between of the selected views. The newly generated virtual views was positioned on a straight line, with varying position along Z direction.

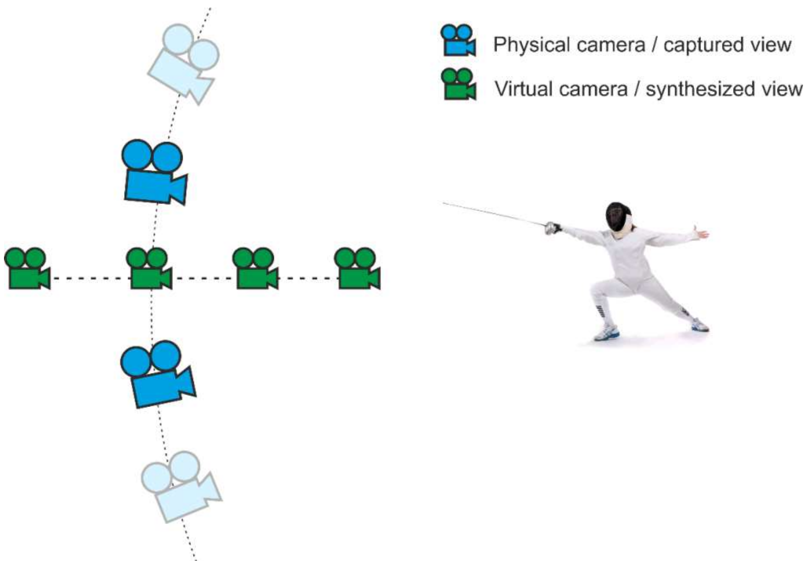

Figure 1. Overview of the step-in and step-out experiment.

For the experiment we have selected “Poznan Fencing 2” [2] because this sequence has been previously assessed by the group as providing good quality synthesis results.

For the rendering, we have used Poznan University of Technology proprietary rendering software [3]. This software provides color compensation capability, unavailable in VSRS, which provides higher quality of rendered intermediate views. It must be noted, however, that in some part of the experiment this feature had to be turned off due to problems with z-near/z-far range. I.e, while stepping-out, the z-near-z-far range of the synthesized view is wider than z-near-z-far range in the original input views. Unfortunately, the current implementation of color compensation tool in our software requires that those z-near-far-ranges are the same, and thus stepping-out is impossible while using color compensation.

A set of rendered views represent distance traveled along Z equal twice a distance between selected input views (see Table 1).

Table 1. Virtual view position and physical camera position used for rendering

Sequence name	Physical camera positions	Virtual camera positions
Poznan Fencing 2	(4, 5)	from 4.5→-200% to 4.5→+200%

3. Subjective quality evaluation

For the subjective quality evaluation we have followed agreed methodology defined in EE [1]. From the generated set of virtual views we have generated video by sweeping over all virtual viewpoint (Fig. 2). The furthest positions of the rendered virtual views: while stepping-out and stepping-in, are presented in Fig. 4 and Fig.5, respectively.

Stepping-in is presented both with and without color compensation (Fig 3 and Fig 4), steeping-out only without color compensation (Fig. 5) due to reasons stated in section above.

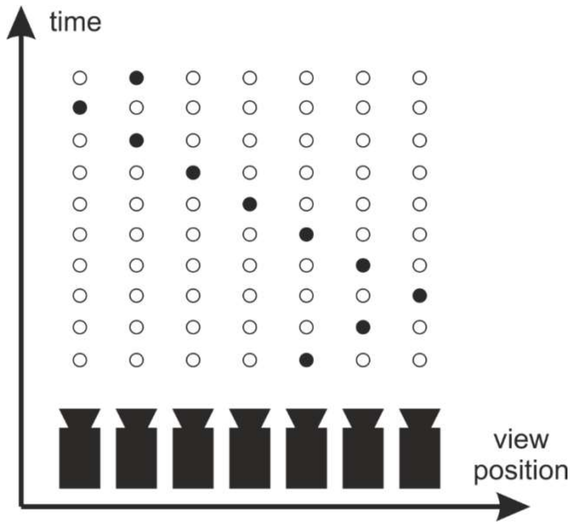

Figure 2: Sweeping video generation

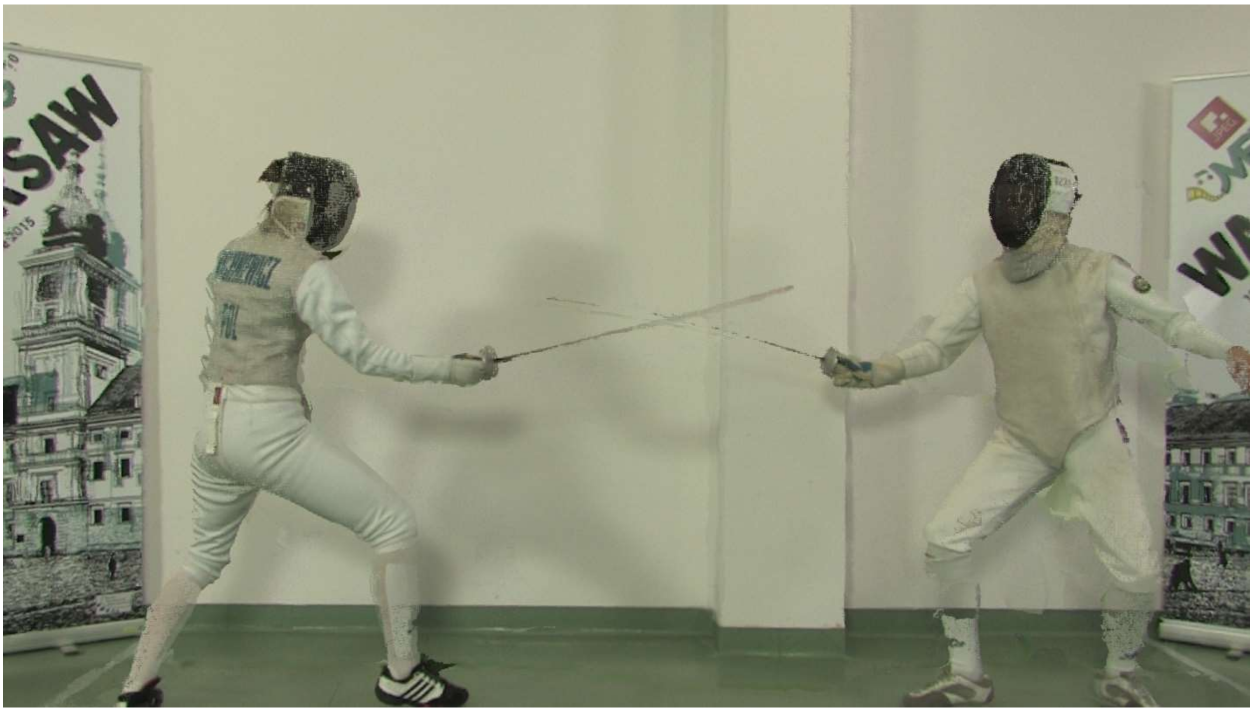

Figure 3. Synthesized step-in frame of "Poznan Fencing 2" [2] sequence, using Poznan University of Technology proprietary view rendering software [3] with enabled color compensation. This version of software is unable to render step-out frame because of z-near-z-far range limitations.

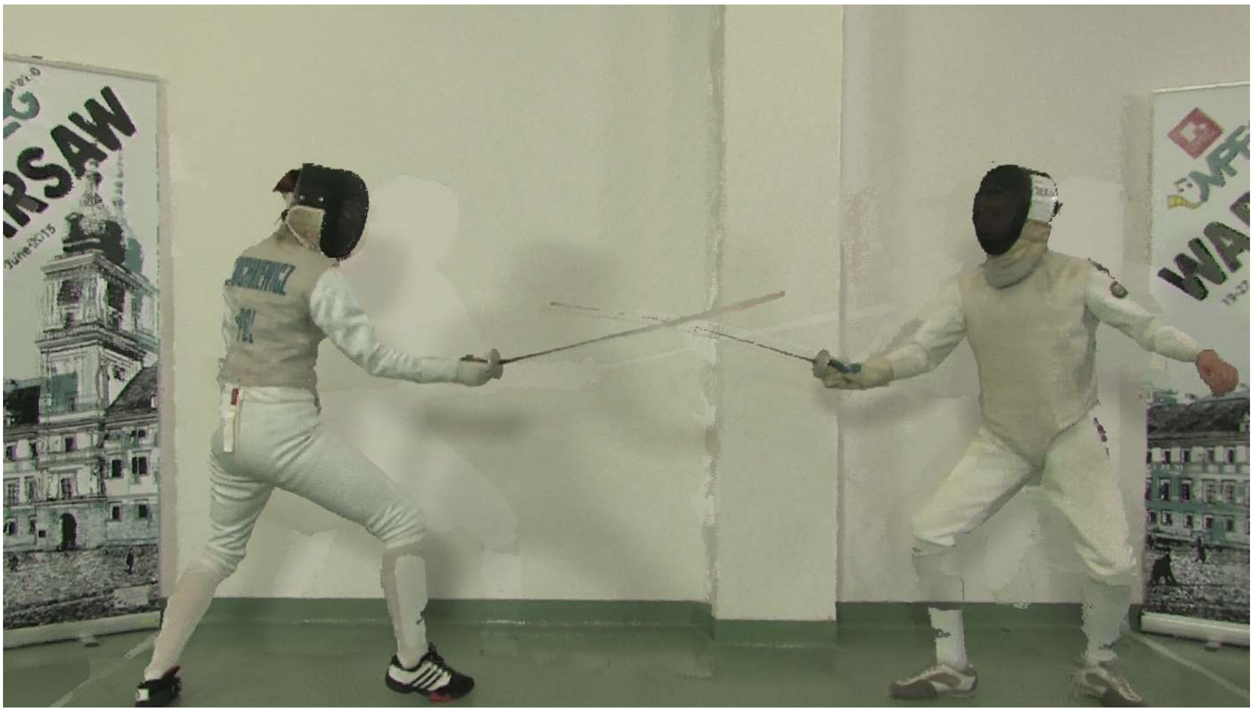

Figure 4. Synthesized step-in frame of "Poznan Fencing 2" sequence [2], using Poznan University of Technology proprietary view rendering software [3] without color compensation. This version of software does not have z-near-z-far range limitations.

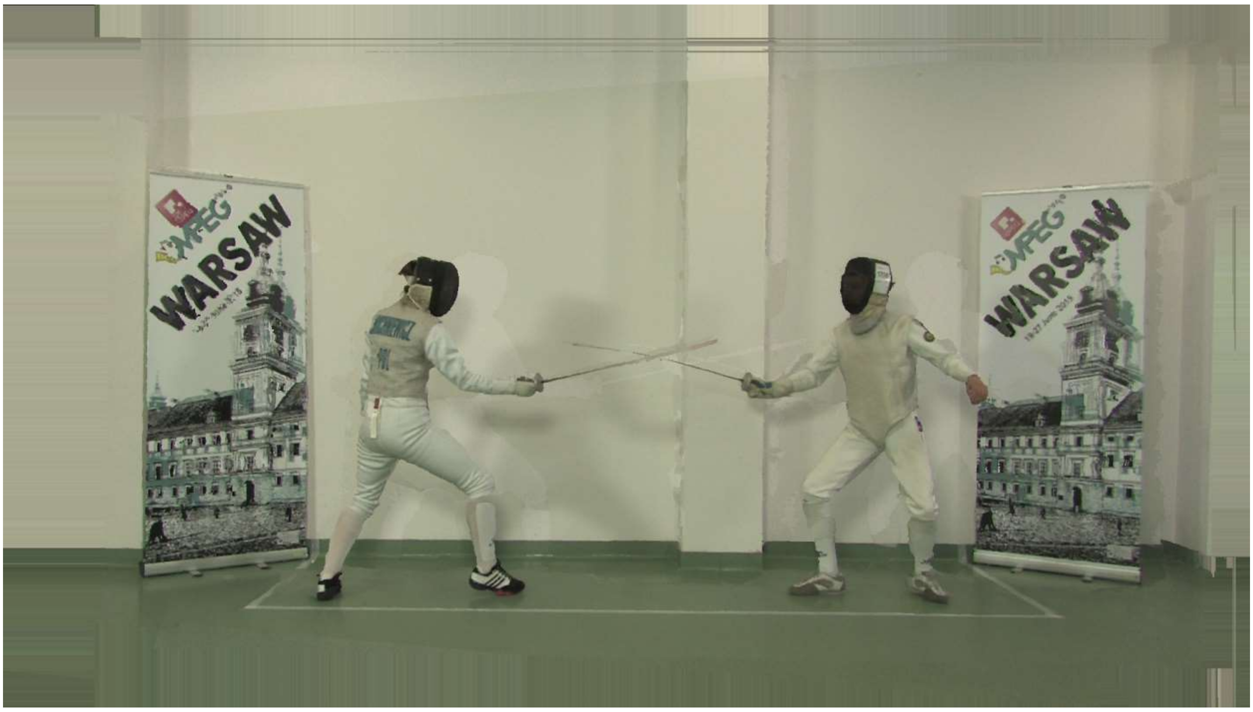

Figure 5. Synthesized step-out frame of "Poznan Fencing 2" sequence [2], using Poznan University of Technology proprietary view rendering software [3] without color compensation. This version of software does not have z-near-z-far range limitations.

4. Conclusions

We have presented that it is possible to render high quality virtual views showing stepping of the viewer in and out of the scene. It is worth to stress, that stepping-in and stepping-out mean to walk inwards and outwards, and not zooming-in and zooming-out. Therefore it can be concluded that the current state-of-the-art view synthesis technology is able to synthesize virtual views not only placed on the plane of cameras.

5. References

[1] Gauthier Lafruit, Joël Jung, Krzysztof Wegner, Didier Doyen, "Exploration Experiments for MPEG-I: Windowed-6DoF", ISO/IEC JTC1/SC29/WG11, n16767, Hobart, Australia, April 2017.

[2] Marek Domański, Adrian Dziembowski, Adam Grzelka, Dawid Mieloch, Olgierd Stankiewicz, Krzysztof Wegner, "Multiview test video sequences for free navigation exploration obtained using pairs of cameras" ISO/IEC JTC1/SC29/WG11 MPEG2016/m38247, Switzerland, Geneva, May 2016.

[3] Marek Domański, Adrian Dziembowski, Adam Grzelka, Łukasz Kowalski, Dawid Mieloch, Jarosław Samelak, Olgierd Stankiewicz, Jakub Stankowski, Krzysztof Wegner, "Technical Description of Poznan University of Technology proposal for Call for Evidence on Free-Viewpoint Television", ISO/IEC JTC1/SC29/WG11 MPEG2016, M37893, San Diego, US, 22-26 February 2016.