*International Journal of Advanced Smart Convergence Vol.10 No.3 157-162 (2021)*
*http://dx.doi.org/10.7236/IJASC.2021.10.3.157*

IJASC 21-3-20

# Case study of Creating CG Handheld Steadicam using maya nParticle

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### *Abstract*

*With the recent increase in YouTube content, many YouTubers are shooting with a handheld camera. Audiences are increasingly accustomed to the movement of handheld cameras. As the camera moves faster than the camera movement of the old movies, and the camera moves splendidly to the music of the music video, the camera movement in CG animation is also needed to change. The handheld Steadicam creates a natural camera movement by compensating so that the screen does not vibrate significantly even when the vibration is large and by minimizing rotation. In order to implement such camera movement, we tried to make a handheld Steadicam using nParticle simulation of Maya software and apply it to the scene to verify whether it is possible to implement the necessary natural and various movement.*

***Keywords:*** *Animation Production, Handheld, nParticle, Steadicam, Maya software*

## 1. Introduction

Recently, there is a phenomenon that the handheld camera technique used for live action tries to express the same type of feeling not only in 3D animation for theaters but also in CG cameras of various platforms. Handheld means that the camera is not fixed with a mechanical device in the dictionary, but is directly held and photographed[1]. It can be said that World War II was the driving force behind the development of hand-held shooting. Videos shot during this period were widely used to capture hyper-realistic scenes using a convenient handheld camera due to the terrain and time constraints of the front during battle. As many cinematographers entered the film industry before and after the war, these camera techniques were used extensively for fights or for depicting tense and chaotic scenes[2]. The speed of camera movement can be slow, medium, or fast on the screen. In general, slow camera movement lowers visual tension, and fast camera movement increases tension in physical visual differences[3]. An important element in the '3 Act structure' is to create emotional tension and relaxation in each stage to increase the audience's immersion, and the role of the camera is very important in this case. A smooth or frantic camera movement in the composition of the scene makes it possible to feel the fact that the visual perception is consistent with the nature of the movement. In other words, if the handheld camera technique is used to film violent scenes or turbulent situations, the emotional cognitive effect can be further amplified by the sense of movement of the camera[4].

Manuscript Received: August. 9, 2021 / Revised: August. 15, 2021 / Accepted: August. 17, 2021
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CG cameras generally do not move in real time, but move by specifying a position by time in CG space with keyframes, so they are based on very stable movements. Therefore, additional keyframes are needed to create the emotional movement of a handheld camera. So, we usually use a compositing tool like 'AE' with RedGiantsoftware plugin to artificially create the movements of handheld cameras such as earthquake, car shake, and walk shake using a rendered image sequence. However, as the demand for natural and dynamic CG camera movement in the CG space is increasing, the need for a CG camera that can be used like a handheld Steadicam is increasing. As shown in Figure 1, A handheld camera movement is required not only for images such as following fast-moving objects or fighting scenes, but also for music videos of virtual musicians and virtual YouTubers. The handheld Steadicam creates a stable camera movement by compensating so that the screen does not vibrate too much and minimizing rotation even when there is a lot of vibration. In this paper, we tried to find a way to realize the movement of handheld Steadicam with a CG camera. And we try to apply the CG camera to the scene that requires a handheld, compare the before and after applying the handheld camera, and judge the pros and cons.

**Figure 1. Scene using of Handheld Steadicam [5]**

## 2. HandheldCam Production Pipeline

By default, the handheld Steadicam will follow the movement of the cameraman who is filming. The handheld Steadicam makes relatively stable movements against the cameraman's rough movements up, down, left and right. To apply this to CG, handheld Steadicam should first follow a moving object. Here, the moving object can be used as a non-handheld camera instead. The role of this camera is to make the basic movement of the camera by designating keyframes and to check the screen composition of handheld Steadicam. Let's name the camera 'animCam'. And we will name the handheld Steadicam produced with CG as 'handheldCam'. The movement of the handheldCam can be created using a single nParticle so that the nParticle move around the animCam according to the movement of the animCam. Among the properties of an nParticle, the most important factor can be said to be influence. By controlling the influence of , we can control the secondary movement of the handheldCam.

### 2.1 Basic principles of handheldCam

The biggest feature of a handheldCam is that it stabilizes the position value and minimizes the rotation value. An attempt was made to find a changing position value using the characteristic that an nParticle do not move away from the center of the object, and a handheldCam was connected to the position. In this case, the rotation value of an nParticle is not connected to the camera. This is because the desired screen composition cannot be created when the rotation value is connected to the nParticle. To create a desired screen composition, the rotation value of handheldCam should follow the rotation value of animCam. Based on this basic principle, as shown in Figure 2, the production of the Handheld Cam can proceed. Start by creating an nParticle. Click the nParticle Tool in Maya's nParticle section to create a single nParticle. And to change the shape of the nParticleShape so that we can see the position of the nParticle, change the particle Render Type in the channel window from Point to Spheres. At this time, it is necessary to check whether the pivot position of the nParticle is at the center of the nParticle. In case of mismatch, it is necessary to adjust the position of the pivot.

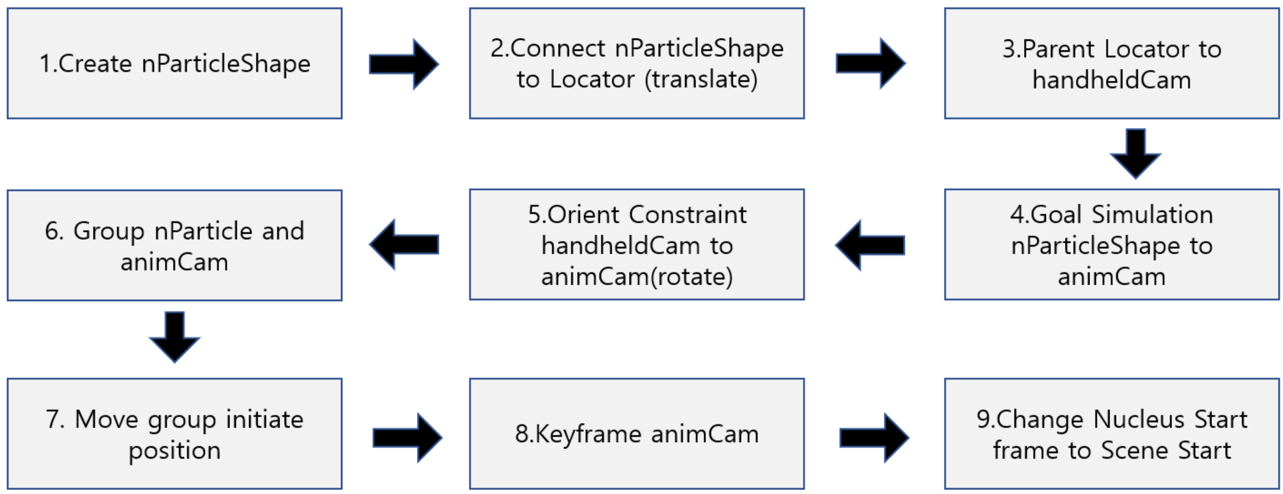



**Figure 2. handheldCam Production Pipeline**

### 2.2 Connection between nParticle and handheldCam

As shown in Figure 3, to connect nParticleShape and handheldCam, first create a locator and connect with nParticleShape first. Connect the nParticleShape's worldCentroid and the Locator's traslate in Connection Editor window. Locator will move according to the nParticle's translate.

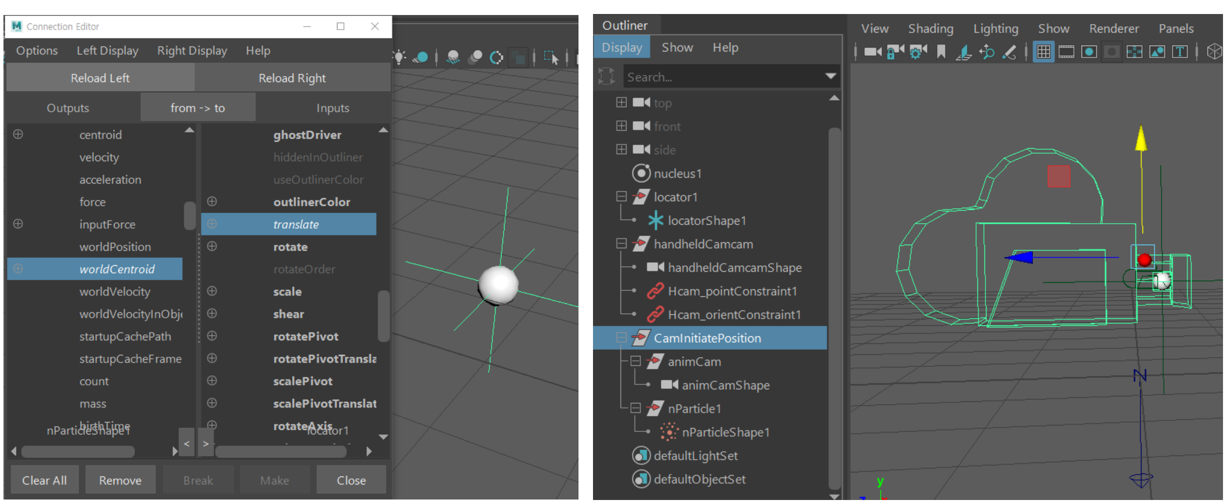



**Figure 3. network structure of handheldCam**

### 2.3 Setting of animCam and handheldCam

The camera connected to the locator is a handheldCam. Simply connect the camera to the locator by parenting. Since the handheldCam is connected to the simulated nParticle, it is difficult to initially set the position of the camera, and it is difficult to set the exact camera view at a specific position. That is why animCam is necessary. With the animCam, the screen composition required for the camera's movement is set as a keyframe, and the handheldCam follows the set animCam's movement. The handheldCam changes the screen naturally and dynamically while maintaining the screen composition set in animCam as much as possible. We can add Goal Simulation to the nParticle properties to make the nParticle move along the animCam. Now, the handheldCam connected to the nParticle will simulate moving along the animCam. In order to make the handheldCam rotate according to the screen composition set by the animCam, an orient constraint is applied so that the rotation value of the handheldCam is constrained to the animCam. Finally, as shown in Figure 3, nParticleShape and animCam should be grouped.

Since the position of the animation is always changed, the position of the animCam needs to be moved. To move the initial positions of the handheldCam and the animCam together, create a group of nParticle and animCam and move it as shown in Figure 3. One thing to keep in mind is that the group exists for initial positioning and subsequent camera movements must be moved by animCam. Because the nParticle is simulated according to the movement of the animCam, if keyframes are not applied to the animCam and keyframes are applied to the group, the nParticle is not simulated and the handheldCam does not move.

## 2.4 Scene Placement of handheldCam

Move the CamInitiatePosition group to get the initial camera composition needed for the scene. Move the group to get the initial camera composition needed for the scene. After that, use animCam to designate keyframes for necessary camera movement. Finally, we can assign the start frame value of the nucleus engine to the frame where the scene starts. If we want to create a camera movement that follows a fast-moving object, create enough simulated time space before the required frame. Otherwise, the handheldCam accelerates to follow the object, and in this case, the movement of the camera that fluctuates greatly is simulated. In this case, it can be solved by adjusting the Goal simulation properties of the nParticle as shown in Figure 4. We can strongly control the movement of the nParticle by assigning keyframes to properties.

## 2.5 Applying handheldCam to action scenes

We applied handheldCam to a scene that follows a fast-moving bike. A handheldCam that follows a fast-moving bike had a problem from the start frame. In the case of the handheldCam we made, a certain time space is required before moving quickly. So, we can think of two solutions, the first is to make the animCam move at the speed of the bike before the start frame of the scene. The second is to adjust the Goal weight as shown in Figure 4. As we can see in the picture, the weight of the animCam was set close to 1 at frame 0 when the scene started so that the handheldCam was attached to the animCam and started to move. And at frame 15, the weight was set to 0.5 to release the constraint on the handheldCam. This will reduce the amount of movement that is relatively large relative to the camera's sudden acceleration at the start.

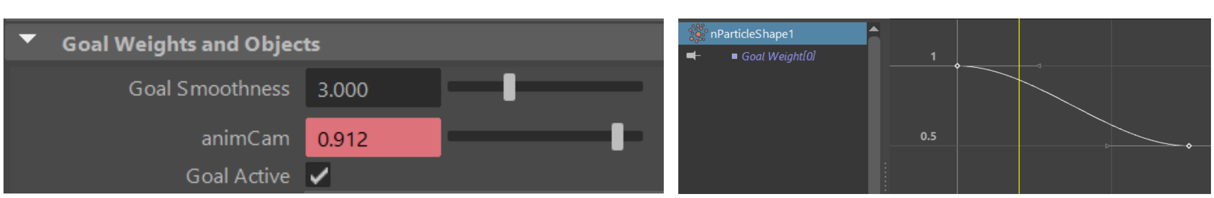


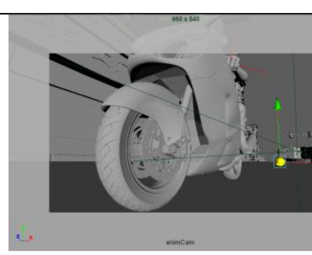
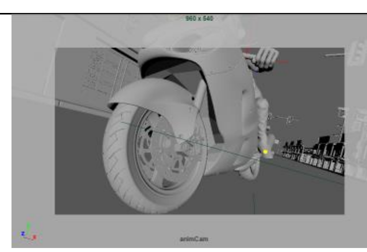
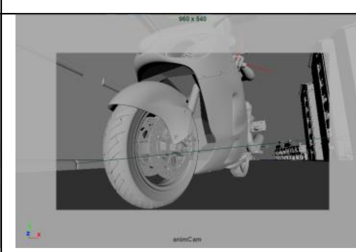
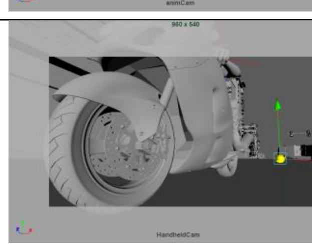
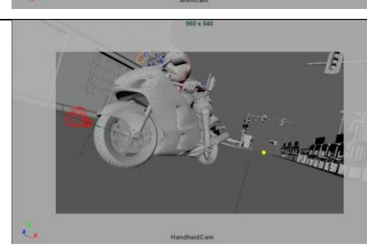

**Figure 4. HandheldCam's Goal weights adjustment**

And the body of a fast-moving bike is supposed to vibrate up and down. Since the animCam is connected to the body of the bike, we cannot feel the vibration of the bike on the viewer of the animCam. This is because the body of the bike and the camera move together. However, in the handheldCam viewer moving relative to the animCam, the vibration of the body can be felt as shown in Figure 5. To check the movement, we connected a locator to the handheldCam and baked the movement of the locator to make a graph.


**Figure 5. Relative motion graph of handheldCam to animCam**

The scene in which the bike moves is from 0 to 110 frames. We compared the scenes shown by the animCam and the handheldCam in the continuously moving bike shots from frame 0 to frame 110. Looking at Table 1, the screen composition of animCam connected to the body of the bike looks almost unchanged at 15, 75, and 95 frames. It is difficult to get the dynamic feel of the bike other than the background change. Frames 15 and frame 95 are scenes running on a straight road, and frame 75 is scene running on a curved road while rotating the bike. In the case of handheldCam, the image of 75 frames, which is the rotating section, adds a sense of rotation as the camera moves away from the bike. Images of 15 frames and 95 frames running in a straight line are also changed and dynamic compared to the animCam as the camera moves up and down. The size of the movement change of handheldCam for animCam can be controlled by Goal Weight, which is an nParticle property. If we want the camera to move relatively large relative to the moving object, we can lower the weight. If we want the camera to move relatively small, increase the weight value close to 1.

**Table 1. Comparison table of animCam and handheldCam**

| | 15 frame | 75 frame | 95 frame |
|---|---|---|---|
| animCam |  |  |  |
| handheldCam (Goal smoothness 0.3, Goal weight 0.5) |  |  |  |

It can be seen from Figure 5 and Table 1 that handheldCam can change the screen composition of the anim Cam to a more natural and dynamic screen. Because nParticle simulation is used, there was a problem that the camera vibrated at the beginning of the scene where the camera should move quickly. In this situation, as shown in Figure 4, it was possible to solve the problem by specifying a keyframe to control the influence of the Goal weight value, which is an nParticle property.

## 3. Conclusion

Compared to the past, the movement of the camera is becoming very important in recent video contents. In movies, animations, or music videos, we can see the cameraman moving dazzlingly with a handheld camera to the music. Because the movement of the camera that shoots digital actors is also required to change, we tried to make a movement such as handheld Steadicam suitable for the required environment in conjunction with the nParticle. Compared to animCam designated as keyframe, handheldCam can make more natural and dynamic movement through examples. This method can also be applied to a two-node camera. The existing two-node camera makes the target object appear to be fixed in the center of the screen. To reduce the feeling that the target object is fixed on the screen, the proposed handheldCam can be connected to the node of the target object. In this way, the target object will naturally move up, down, left, and right in the center of the screen little by little. It can also be applied to a two-node camera to create a natural screen composition. This study has academic significance in that the motion of the live shooting Steadicam was implemented with CG software using particle simulation. And it is thought that the development of this technology will help to more easily express the natural and stable camera movement in the existing animation production.

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