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Independent Study: Motion Capture

Made possible by the mentorship of Cheryl Briggs

Retrofitting a Fully Articulated Film Rig for Motion Capture

As “Downhill” is a sizable production featuring four separate character rigs, considerable complex prop interaction, and intricate acting, the majority of the final year of production is dedicated to animation. To streamline this process and aid in meeting tight production deadlines, motion capture was considered as a supplementary animation technique.

In choosing to include motion capture as a method of animation, it is important to consider the impact motion capture has on the final “feel” of the animation. Keyframe animation is often considered more “artistic” as it allows for more of the artist’s original intent to shine through. It offers the animator the ability to bend the laws of physics, motion, and anatomy to manipulate the audience’s perception of the persistence of vision, creating something that feels correct to the eye without the restrictions of the physical world. In the words of Tsai-Yun Mou, “traditional keyframe method has better support for [the animators] to express their creativity in the originality aspect” (Mou, Keyframe or Motion Capture? Reflections on Education of Character Animation). For this reason, a critical defense of Downhill existing as an animated short revolves around the heavy use of keyframe method.

This then posed a new challenge; would it be possible to elevate motion capture data to the same level of expression as its keyframed counterpart? If possible, motion capture would remain a viable supplementary animation method. Otherwise, it could not be used on threat compromising the charm of the medium and working against the purpose of the thesis.

Throughout this paper, various attempts at retrofitting a fully articulated film rig and replicating artful, expressive motion through modified motion capture are documented. While exceptionally useful in theory, motion capture was not integrated into the pipeline until late in production; this resulted in several complications that slowed integration considerably.

First and foremost, the full, film-ready rig could not be easily mapped to the humanIK skeleton[1] provided by Maya and Motion Builder. This is because the motion capture pipeline has been optimized for games, and game rigs are often required to be "lighter" or less complex than film rigs due to the stringent requirements of real-time rendering. For this reason, ribbon splines (which are often used to create stretch and bend in film rigs) are not supported. For the father's rig (henceforth referred to as "GE" or the "GE rig"), ribbon splines were superfluous in all limbs but critical for the spine and neck. This served as a stop in integration as workarounds were considered.

The first attempt involved creating a new series of joints to act as a "game ready" spine. The chain began at the pelvis and continued through the neck until it reached the head joint. Every ribbon-spline joint had a corresponding game-ready joint. The ribbon spline joints were then parented underneath the new game-ready joints with the intention of linking the game-ready joints to the humanIK setup and allowing them to drive the skinned ribbon joints. This was unsuccessful, as the connections between the ribbon spline's driver joints contended with the parent constraints coming in from the game-ready joints and resulted in inconsistent and undesirable mesh deformation (fig 1).

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[1] *The process of mapping the skeleton was learned through Patel's "Maya - How to Apply Mocap to Any Rig Using HumanIK in Maya" tutorial.*

Figure 1

Many variations of this method were attempted. The second time, game-ready joints were created over the ribbon spline's driver-joints. In this way, the game-ready joints would be driving the joints that controlled the ribbon-spline's deformation. The data would be passed from the humanIK skeleton to the linked game-ready joints to the driver joints, resulting in movement. While this did work in Maya, transferring the rig with both the game-ready driver joints and the ribbon spline joints offered a litany of errors in Motion Builder. Mesh components were severely displaced, joints were severely displaced, and adjusting the animation became impossible. However, this method was not entirely useless, and did make it possible to re-apply the motion later in the process.

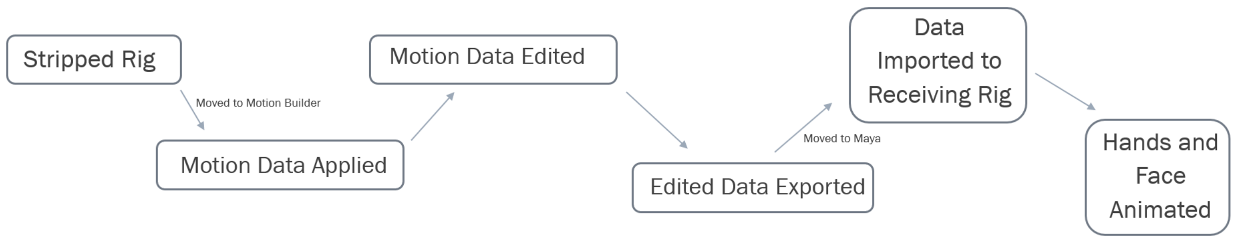
The next roadblock integration faced came from the advanced facial rig and hands. While in most cases both are simple joint-driven set ups in games, the GE rig includes a complex network of blend shapes, joints, and offset groups that made transferring it into Motion Builder very difficult if not impossible. For this reason, rather than finding a workaround, the facial rig and hand rigs were stripped from the motion capture rig. While in practice motion capture data could be captured for both aspects of the rig, continuing to troubleshoot and rebuild those sections was deemed too time consuming and inefficient. Additionally, hardware limitations prevented further integration (facial capture hardware was not available).

Eventually, after these problems were identified and the advisor (Cheryl Briggs) had been extensively consulted, two GE rigs were created. The first included the driver-joint workaround outlined earlier, the hand rig, and the facial rig. The anatomy of this rig (the “receiver” rig) did not lend itself to working in Motion Builder. However, it did accept data mapped to a humanIK skeleton. In this way, it would allow motion capture data that had been processed in motion builder to be re-applied in Maya. With this pipeline, this rig could keep all of it’s dynamic data, XGen data, and facial/hand rigging without issue.

The second rig, or the “motion capture” rig, was built to be used and adjusted in Motion Builder. It was stripped down to the barest essentials; the IK/FK legs and arms, the ribbon spline and it’s associated follicles, joints, and drivers, the XGen nodes, the facial rig, it’s offset groups, all accessory rigs (the hat), and hand rigs were removed. This left nothing aside from the skinned mesh and the skin joints, parented as a game rig would be. To allow maximum compatibility in Motion Builder, the pelvis joint was parented under a “root” joint that then became the child of a “reference” locator. This is the format Motion Builder recognizes and allowed for a cleaner schematic view.

In doing this, the ribbon and neck ribbon splines were deleted. What remained were the “game-ready” joints that were created in the same location as the ribbon driver joints. The torso was re-skinned to these game-ready joints for this rig only to allow for an accurate preview of the motion in Motion Builder, but these skin weights were not used in the final product.

With this done, the pipeline was set. Data captured externally could be mapped to the “motion capture” rig in Motion Builder. This data could then be adjusted appropriately, adding exaggeration, removing any hard stops, errors, or undesirable arcs, and exported back into Maya to be mapped on the “receiving” rig. With the edited data mapped in Maya, the animation of the hands, hat, and face could be done by hand and no XGen patches needed to be reskinned.



Of course, preparing the rig is only half the process; capturing the data is its own undertaking. Fortunately, the artist was able to utilize the largest motion capture studio on the East Coast and the varied talents of the University of Central Florida’s acting students to capture the raw data. This process presents a unique environment in which actors are asked to perform against proxies and blank space. Coupled with the stringent requirements of individual film shots (as opposed to the general library of motions required in games), and an environment is created in which the actor is forced into an invisible environment and asked to move relative to it. The actors provided had not worked in motion capture previously, and the director was exceptionally inexperienced in guiding live-action actors. For this reason, while data was captured, many takes did not have the energy required for implementation due to the actor's hesitance and the director's lack of concise feedback. While these problems can be fixed in cleanup, more effective raw data could be captured with additional sessions.

Overall, the process of capturing motion was made simple and accessible by both the advisor (Cheryl Briggs) and the faculty at the Florida Institute of Electronic Academy. The stage was exceptionally large, the suits were well-applied and well-captured, and all data—while not perfect for the production—was perfectly useful for the purposes of testing the pipeline.

After data was captured, it was compiled and shared via Google Drive. It was then taken and imported into Motion Builder where all cameras, unused nodes, floating markers, and other miscellaneous data was removed to maintain a clean file. This file was then saved, and the stripped rig was added to the file. After ensuring all mapping was correct on both skeletons and properly characterizing them, the data from the capture was applied to the stripped rig. After it was mapped, the original motion capture data was removed to lighten the file and clean up began.

For the animation used in this test, the actor provided an excellent base under the guidance of "an exaggerated, swaggering walk". From this data, the twist of the torso was adjusted to provide more swing, the body anim was pushed to higher extremes to over-emphasize weight, and the arcs of the arms were pushed further to tie the momentum together. With the raw data adjusted, the file was saved, the data was exported, and the cleaned-up motion was brought into Maya. There were no issues with this transfer.

From there, the data was mapped to the receiving rig using the humanIK window. Upon successful transfer, the face, hands, jacket tweakers, and hat could be animated freely. This pipeline also supported rig additions and changes as long as the corresponding game-ready joints (parented over the ribbon spline joints) were available. This provides security for future iterations of the rig and proves the stability of the pipeline, which is critical for successful integration. Additionally, the resulting animation rendered perfectly. All dynamics, materials, meshes, and XGen grooms were in-tact and no spike in render time was experienced.

Altogether, does this process satisfy the requirements of the project? Upon review, while the animation is identifiable as motion capture when compared to other shots from the film due to its realistic weight and fluidity, test audiences felt the exaggeration was sufficient and the slight differences did not impact the viewing experience. Some even preferred the motion-capture data for it's character (given by the actor's fantastic performance and heightened by cleanup). Altogether, this was a valuable study and learning experience that will benefit both the quality and schedule of "Downhill" that will be utilized throughout the remaining production.

Works Cited

1. Mou, Tsai-Yon. “Keyframe or Motion Capture? Reflections on Education of Character Animation.” *EURASIA Journal of Mathematics, Science and Technology Education*, 20 Apr. 2018, pp. 1–1., www.ejmste.com/download/keyframe-or-motion-capture-reflections-on-education-of-character-animation-5604.pdf.

2. Patel, Bhaumik, director. *Maya - How to Apply Mocap to Any Rig Using HumanIK in Maya*. *YouTube*, 13 Feb. 2019, youtu.be/eiSHnYYciec.