2020
3
ISSN 1433-2620 > 24. Jahrgang >> www.digitalproduction.com
Publiziert von Pixeltown GmbH

Deutschland € 17,90
Österreich € 19,–
Schweiz sfr 23,–

DIGITAL PRODUCTION

DIGITAL PRODUCTION

MAGAZIN FÜR DIGITALE MEDIENPRODUKTION

MAI | JUNI 03:2020

Ausbildung
Was macht eine gute VFX-Uni aus?

Tests
Eizo, Philips, Soundweaver, Woosh und Akeytsu

Projekte
Mulm, The Witcher, Marvel Heros, Walking Dead: Maya

und vieles mehr
Flame, Blender, InstaLOD, Nuke 12.1, Topaz und mehr

Simulating The Incredible Hulk with Ziva & Goldtooth

When Marvel Entertainment needed characters created for their new RPG smartphone app "Marvel: Realm of Champions", they turned to Vancouver VFX studio Goldtooth. In this article, we'll explore how the Goldtooth-team managed to bring one of Marvel's most treasured CG characters, the Incredible Hulk, to life in just three days.

by Irene Pu, Lead Rigger

To kick off 2020, Marvel is expanding their footprint into the world of role playing games in the form of a smartphone app. "Marvel: Realm of Champions" is a mobile RPG that reimagines the Marvel universe and 11 of its popular superheroes in a universe-wide battle themed around the Secret Wars from 1984. Recently, we were tasked with creating an engaging game trailer to help hype the release.

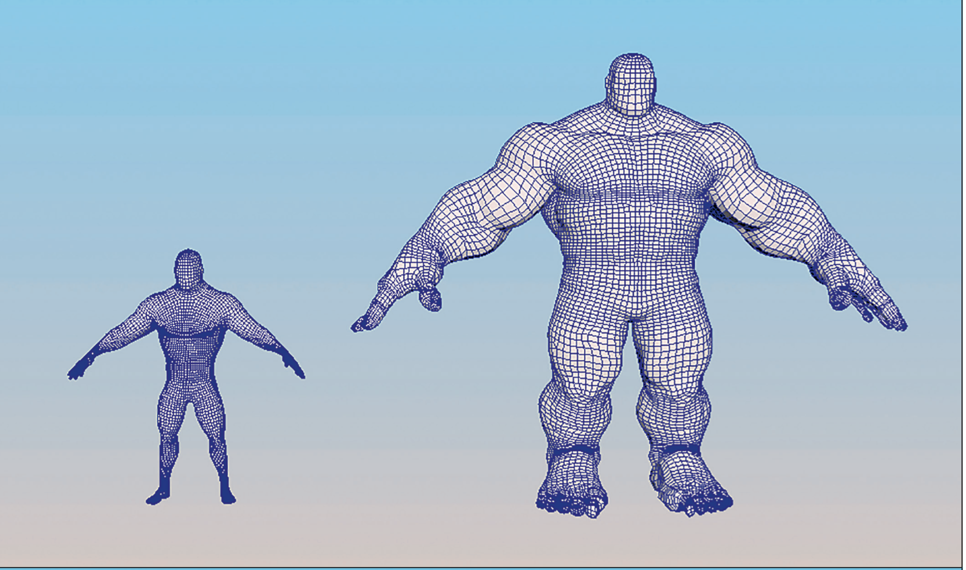
Even with Marvel's sky-high quality bar and the inherent pressure of showcasing 11 well-known CG stars, we were given only two months to bring the entire production to life. It is not uncommon for studios to work under such high-pressure conditions. With audiences constantly craving better looking characters and more of them, production companies frequently demand eye-catching results with extremely tight turnarounds. After the first mocap shoot and board edit approval for "Marvel: Realm of Champions," we were left with only 1 ½ months to make it all happen. Keep in mind, the Incredible Hulk has been played by 18 different actors and starred in two films, five TV series and 11 games. So we had some massive green shoes to fill!

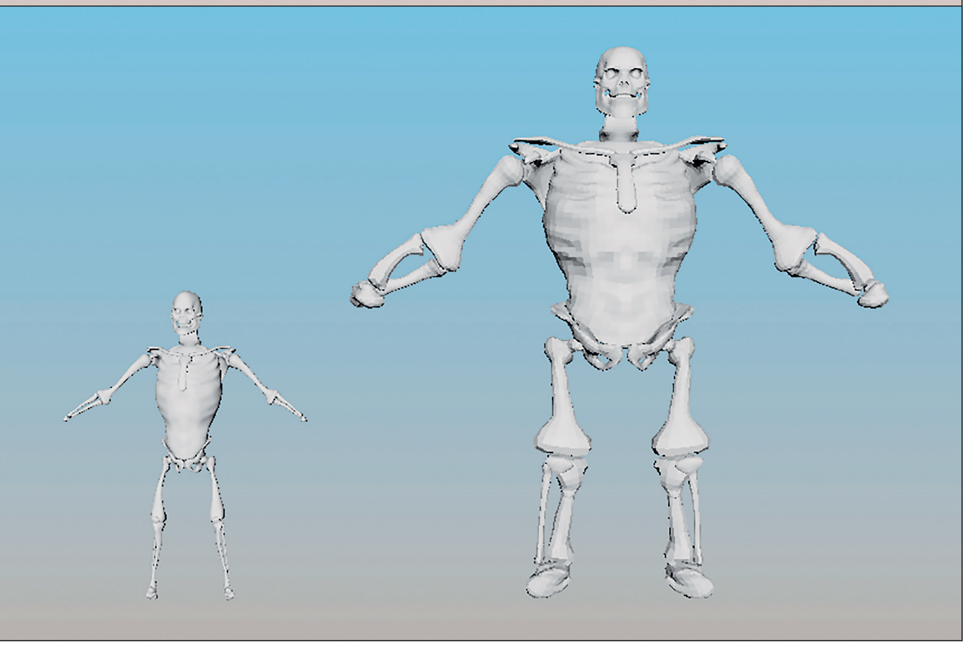
That said, we understood that our previous nCloth and PSD-based approach to character rigging just wasn't going to make the cut for this high-stakes production. We were already encountering major tech difficulties on smaller productions, so we were forced to turn elsewhere. Not long after winning the project bid, we discovered Ziva Dynamics, a fellow Vancouver-based company that specializes in character simulation software. Their main product offering, Ziva VFX, is a Maya plug-in that allows creators to turn any 3D object into a soft tissue, such as muscle, fat or skin. The software's advanced physics

solver rapidly simulates the natural jiggle, stretch and excitation of these materials, so artists can build lifelike creatures that are highly dynamic and scalable. We had heard many positive reviews from close friends in the industry, so we made a point to get in touch with the team and learn more.

Getting Started

We kicked off our Hulk rigging process by acquiring one of Ziva's pre-made assets, named Mr. Ink. The Mr. Ink asset is a simulation-ready biped that comes complete with high-fidelity bones, muscles and fat/skin passes. This free anatomy





was the perfect starting point for our Hulk, as it could be paired with Ziva's Anatomy Transfer (ZAT) tools to quickly generate a lifelike rig. With Anatomy Transfer, artists can take the full internal anatomy of one character (i.e. bones, muscles and the fat/skin layer) and automatically fit it to the external mesh of another, removing the need to start from scratch or spend time manually reworking poor geometry. Although it was a risk to adopt new software and techniques with such a quickly-approaching deadline, we had seen many Ziva success stories coming out of VFX houses like Scanline VFX and Sony Pictures Imageworks, so we decided to take the leap.

Setting Up an Incredible Mesh

In preparation for the Ziva Anatomy Transfer, we needed to ensure that the Hulk mesh met the minimum requirements of the transfer process – both it and the source mesh (Mr. Ink) needed to have the same number of vertices so that an accurate transfer map could be synthesized. For this reason, I decided against altering the existing Hulk mesh and opted to use Mr. Ink as the basis of my creation instead.

I started by importing the Hulk mesh and a copy of Mr. Ink's mesh into a single scene in Wrap 3, a powerful mesh retopologizing tool created by the R3DS team. It offers a host of mesh-altering functions, including decimation tools, filtering tools, texture projection tools and more. I used Wrap 3's landmark-based warping tools to simply alter the shape of the Mr. Ink mesh so that it mirrored the Hulk perfectly, thereby maintaining all of the critical inputs, such as vertice count and resolution, while adopting the perfect silhouette. At this point, the original Hulk model mesh is no longer required in any of the simulation steps. Moving forward, only the new Hulk mesh (derived from Mr. Ink) will be used – it is the Target Mesh and the original (not altered) Mr. Ink mesh is the Source Mesh.

Warping the Bones

With the newly created Hulk mesh ready and waiting, it was time to make use of the original Mr. Ink asset to get started on the Hulk's bones and skeleton. To do so, I used Ziva's Bone Warper. As the name suggests, the Bone Warper is a specialized tool for warping Maya meshes that represent bones in a simulation, a.k.a. non-deformable objects. The Incredible Hulk's bone warp went as follows:

1. Open a single scene with the Source Mesh and bone layer (Mr. Ink) alongside the new Target Mesh (Hulk).
2. Select Mr. Ink's mesh.
3. Shift+Select the Hulk's mesh.
4. Marquee select all of Mr. Ink's bone geometry.
5. Then, click the Bone Warp button found in the Ziva menu.

Within seconds, the entire bone geometry of Mr. Ink is transferred over to the Hulk mesh and is warped to fit within the confines of its new mesh environment. Any ill-fitting sections are then smoothed down by interactively painting additional landmarks on the newly transferred bones. Landmarks, much like in Wrap 3, are key points on the surface of the mesh that are forced to preserve their relative positions during the warping process.

This process was immensely quicker and easier than what we were used to. In the past, we typically relied on Maya's Wrap Deformer to try to warp the bones and muscle anatomy to new asset proportions, but the results always introduced a number of problems – lots of mesh shearing, self collisions and tons of clean-up. The meshes that would come out of Maya's Wrap Deformer were also very wobbly and required a fair bit of additional sculpting to smooth out the geometry and fix head insertions. After all that painstaking work, it would often feel like an entire redo.

Ziva's Bone Warp solved all these problems, and I love how effective the landmark positioning is. It conserves the bone's overall thickness and keeps the bones straight, which is unique to Ziva. Best of all, the Bone Warp gives the user parameters so that they can edit how detailed they would like the transfer to be. Once the bones and muscles were warped with Ziva, the clean-up was minimal. Ziva took the heavy lifting out of transferring setups, so I got to focus on the fun stuff sooner.

MoCap Retargeting

It is important to remember that there are numerous moving parts in the creature pipeline, many of which can actually take place concurrently to avoid undue waiting or bottlenecks. Animation and rigging are two steps that can often benefit from some strategic planning and collaboration.

In the case of "Marvel: Realm of Champions", our team had scheduled their live motion capture shoot about a week before any actual rigging took place. So, the animation team did not have the opportunity to use Mr. Ink's skeleton as reference for their mocap. Instead, we provided the capture studio with a standard skeleton. It had points that were carefully placed in the center of the mesh body and limbs.

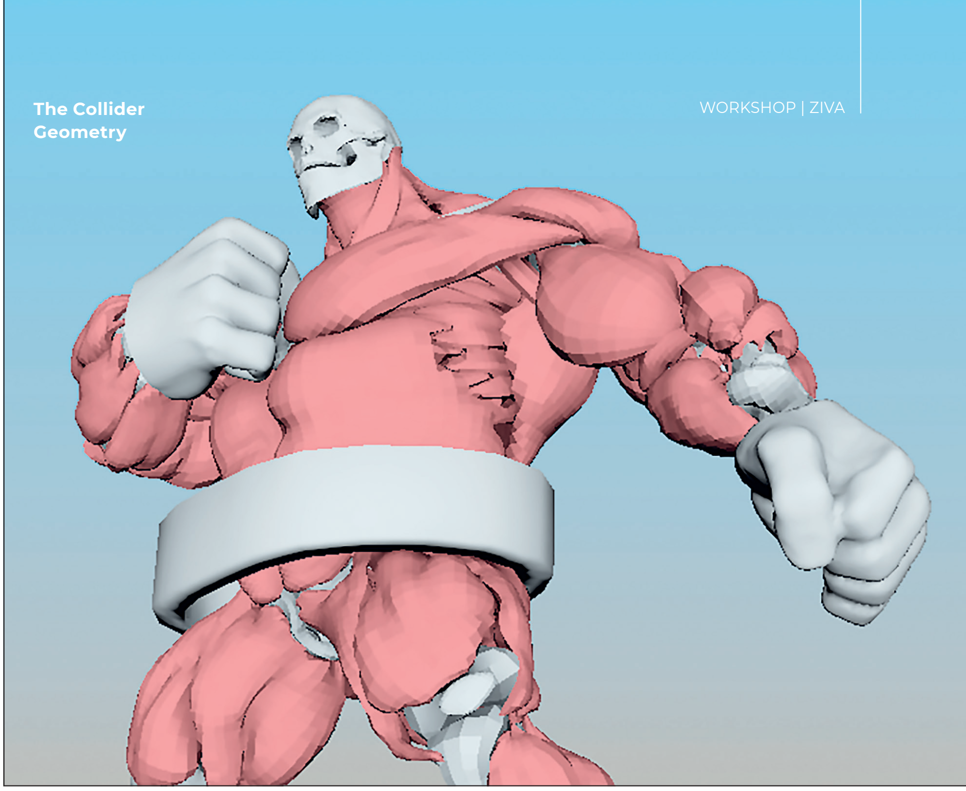
When we realized we wanted to sim the Hulk using muscle simulation, I had to re-rig the Hulk with an anatomically correct skeleton. This also meant that we'd need to retarget the animation data from the generic skeleton to the anatomically correct skeleton. Standard target skeletons used in these sessions do not traditionally account for anatomical structures, because anatomy-based rigging is still a fairly new concept. So rigging worked together with animation to make sure that the animation of the Hulk still fit the comic-like action animation, with some poses exaggerated, and that the animation was also not cheated to camera.

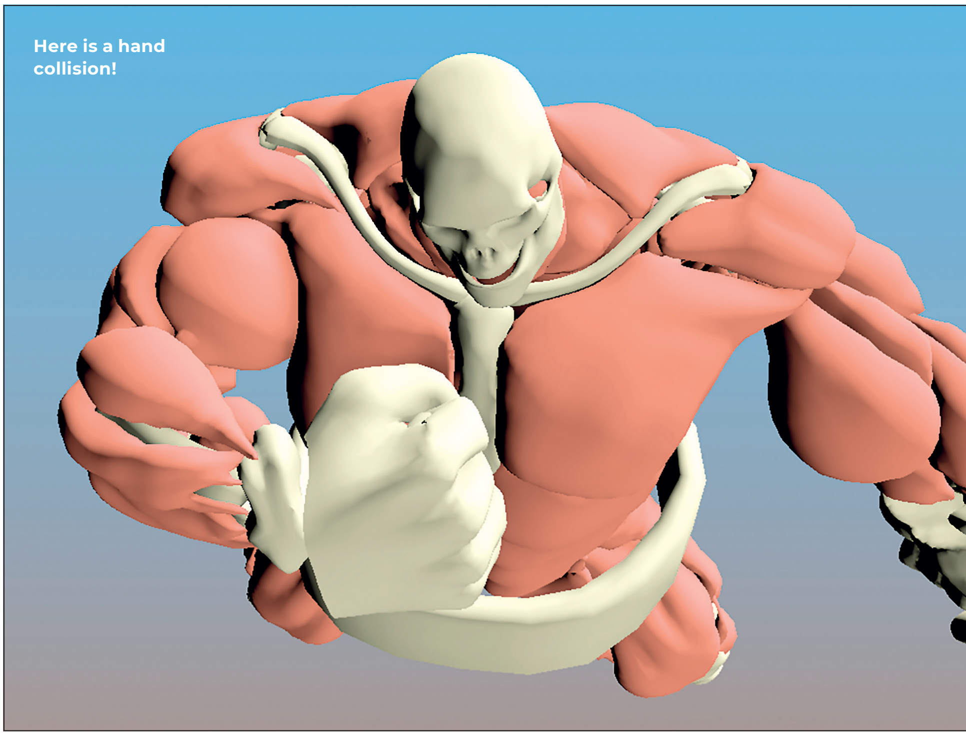
To make sure that the Hulk was going to move in a realistic way, the animators were given the ability to cross-check their animation with the anatomical bone setup. Thus, they were able to make sure that the distances between bone segments were true-to-life and anatomically sound. The relationship between the clavicle bone and the ribcage, for example, is very important – if the clavicle were raised inaccurately high, it would cause a tissue tear. The animators also paid close attention to wrist rotation by looking at the twisting of the radius and ulna.

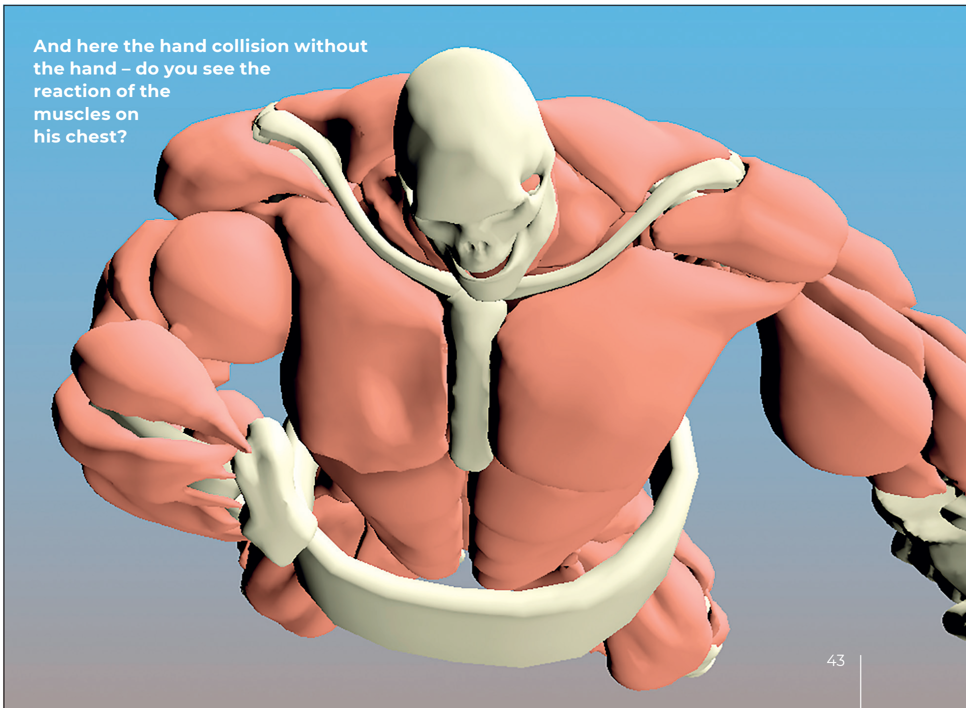
Although it took our animation team a bit of extra time to rework the animation rig, the end results were definitely worth it. If we could go back in time, we would have scheduled the shoot after having settled on our rigging approach so that no alterations to the capture skeleton would need to be completed retroactively.

Warping Everything Else

Now back to the workflow. With the bone warp complete, it was time for Mr. Ink's muscles and skin to be transferred over using Ziva's Harmonic Warper. The Harmonic Warper is the general-purpose tool to warp the deformable geometry (all of Mr. Ink's anatomy and setup) from the Source Mesh onto the Target Mesh. This tool works on polygonal meshes, NURBS surfaces and curves, joints and locators. Seeing as both meshes naturally contain the same number of vertices (because they are essentially just different silhouettes created by the same mesh), I simply had to select the right objects and run the warp. This tool works by mapping the corresponding vertices and creating a deformation field inside the volume enclosed by the Source Mesh. It then trans-


The Collider Geometry


Here is a hand collision!


And here the hand collision without the hand – do you see the reaction of the muscles on his chest?

fers the corresponding tissues and setup to their relative positions.

Hulk's wide and stocky structure required that the team increase the input value of the zHarmonicWarp.surfacePenalty parameter to increase the constraints of transfer, therefore forcing the Mr. Ink Source Mesh to better fit the target. Although increasing this parameter can result in greater instability, we fortunately did not experience any challenges.

The entire transfer process, including both the bones and the collection of muscle and fat/skin passes, each took about half a work day to complete. So, our team – who had never before used Ziva VFX – now had an entire simulation-ready Hulk body within eight hours! This was an incredible feat and really proved the value of Ziva to our team.

Adding Appendages

As you may have noticed from the earlier shots of Mr. Ink, he is missing his hands and feet. For me, this was not surprising. Having worked with assets for over 4 years, I understood that studios often have unique requirements for such appendages, and without one clear objective, it stands the reason that including these extra bits may actually complicate or obstruct the warping processes. That said, I knew the Hulk's hands and feet still needed to be part of the simulations. I had already begun to receive animation sequences from my team, and it was clear that we'd need a collision to occur between his hands and body.

Given Hulk's limited motion, however, he did not require highly performant hands or feet in any of the shots. So, I baked the hand elements as an alembic cache in the animation file. Then, I made that alembic into a zBone object in both the muscle pass and fat/skin pass. Changing an object into a bone is extremely easy with Ziva:

1. Select the object you wish to convert (Shift+select for multiple objects).
2. Go to the Ziva Menu.
3. Go to Add Simulation Component and select Bone.

This approach enabled our team to achieve intense collisions during key moments of the trailer, like when Hulk first explodes onto the scene and smashes his fists against his chest like a mighty gorilla.

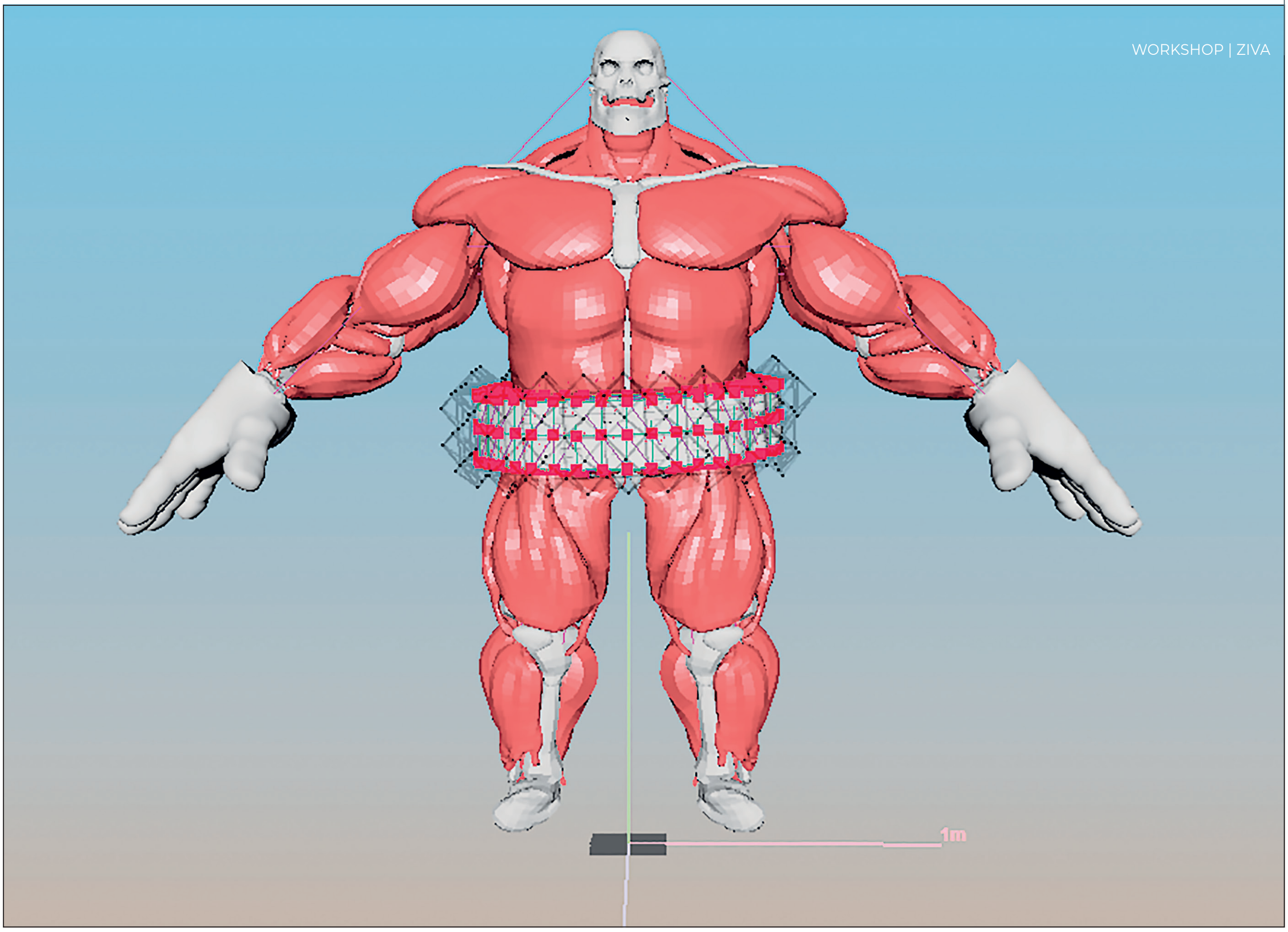
Adjusting the Sims

Speaking of the gorilla sequence, this was one of my favourite shots to work on. It is a crucial moment in Hulk's scene and a prime example of the artistic control I had.

For this shot, our team wanted to express the strength of Hulk's punch by creating a rippling effect on his body. Simulating these intense dynamics on such thick, dense muscle would have been a challenging creative task in the past, likely requiring extensive shot sculpting or corrective shapes. But this time it was surprisingly easy. When unsure of how to achieve the results, I turned to Ziva's online tutorials. There, I quickly learned about Ziva's material variation capabilities and the effects of the many unique parameter settings within Ziva's zMaterial Node. After that, adjusting the soft tissue was easy. I had free reign over the look and feel of the dynamics, and knew exactly how to achieve the dynamics I had been imagining.

Ziva's volume preservation properties let users achieve precise and defined dynamics, even under extremely high force and compression. Whether or not I chose to abide by the natural laws of physics was completely up to my own discretion. To adjust the properties of the pec, I simply added a Material Layer atop the pectoral tissue object. The material layers work by solving the physical properties of the top material layer, covering any underlying materials with complete opacity. The workflow is simple and offers infinite opportunities for material variations:

1. Select the tissue you want to adjust (in this case, Hulk's pectoral muscle).
2. Go to the Ziva Menu > Add Tissue Property > Add Material Layer.
3. Adjust the material's properties by navigating to the Material Node, located above the Channel Box on the right-hand side. The new material is located above the pre-existing base material.



4. Alter and test the new material's parameter settings.

For the Hulk, only the Young's Modulus material parameter needed to be adjusted to get the desired results. Young's Modulus is a common term in engineering used to measure the stiffness of real world materials. In Ziva VFX, the default Young's Modulus value is 3, and Young's Modulus Exponent is also 3, which is representative of typical fat tissue. But we chose to increase this value on Hulk's pectoral, to 12^3. This material is similar to soft cartilage. The remaining material parameters are Poisson's Ratio and Volume Conservation.

Poisson's Ratio

Poisson's Ratio defines the relative change in volume under material stretching and successfully controls volume preservation under small deformations. Values near 0.5 cause the simulated material to act unnaturally stiff, so we don't recommend putting Poisson's ratio below 0.45.

Volume Conservation

Volume Conservation controls the liquidity and compression resistance of a material. Typically, the numeric value for volume conservation is set to be 10^2 – 10^7 greater than that of Young's Modulus. With a sufficient level of volume conservation or compression resistance in Ziva VFX, you can even achieve a soft, goop-like behaviour.

The distinction between Volume Conservation and Poisson's Ratio is that Poisson's Ratio attempts to preserve volume per tet, whereas Volume Conservation considers the entire region – so volume lost in one tet will be pushed into a neighbouring tet. One of the nice benefits of Volume Conservation over just using Poisson's Ratio is that it will help you avoid what is known as locking, which is where the mesh gets stuck because the locally enforced volume conservation makes the tets get wedged together.

That said, neither of these inputs needed to be adjusted for Hulk, since Mr. Ink's original setup was already highly effective. Originally, I tried to change all the attributes to get the results I wanted. But after a bit of tinkering, I realized that once I scaled the solver, everything else scaled too and everything remained stable.

Adjusting the Solve

I originally recognized that I needed to scale the Ziva Solver to compensate for the drastic height difference between the Hulk model and Mr. Ink. Marvel's ferocious green giant is a staggering 2.6 meters tall, while Ziva's Mr. Ink asset is 1.48 meters. To do this, I simply adjusted the solver from 100 cm to 150 cm. Increasing the solver dimension non-destructively forces everything within the scene to increase its relative size. Upon discovering how malleable and robust the solver attributes were, I identified that even more animation hurdles could be solved with simple solver adjustments.

For example, moments before the previously mentioned gorilla scene, the big green humanoid smashes onto the surface of Battleworld at asteroid-like speeds. He appears so quickly, in fact, that he reaches a speed that would only be realistically hit by hard objects, like a plane or an actual asteroid. The sheer velocity of the movement would be entirely implausible on Earth; such rapid motion would cause muscles and fat to literally rip away from bones.

In the past, we often struggled with high-impact scenes like this one. Software would crash, stall or cause unknown errors when faced with creatures moving at unnaturally high velocities. With Ziva VFX, we were actually able to watch the muscles rip from Hulk's body and complete the entire sim! Naturally these weren't the results we wanted, but it was super interesting to see and I was impressed by the software's ability to complete the simulations without failing. Ziva maintained realism even amidst complete implausibility! Because of this, I was also able to diagnose the cause of the flying muscles, which was helpful for fast troubleshooting. To rectify the tearing muscles, I simply constrained the Ziva solver to a rivet. Then, with the simulation world travelling locally with the Hulk, the velocity difference was balanced out.

Making Metal Materials

With the entire Hulk body complete, it was time to add the cherry on top – his bulky metal belt. Although armour is not considered a soft tissue (because it does not return to its natural shape after being subjected to adequate pressure but will instead become bent or dented), Ziva can still be used to simulate its relationship with soft objects during collisions – which is exactly what we needed. To incorporate a hard object into a simulation pass, you can either solve the hard object by increasing the object's density (essentially making it a very hard deformable object) or turn it into one big non-deformable bone. Depending on the external object of your making, either approach may be more or less suitable. I decided to use a combination of the two to simulate the Hulk's armour.

I started by importing a cached proxy of the belt, then turned it into a single bone object, just as I had done with the hands. Although this would often be enough, after looking at Hulk's muscle simulation, I realized that the belly muscles bulged out quite a bit when he was crouching down. I felt that some of that awesome belly bulge would affect his chain belt, and the rigidity of the chain belt would also affect how the belly muscles would mush against it. It was the perfect opportunity to test out how Ziva would react when simulating a soft tissue against a really rigid tissue object. So, I decided to add a hard tissue layer on top of the belt.

Then, I simply searched for the Young's Modulus value of steel in the Ziva Documentation and entered my findings into the material settings. Since Ziva VFX is based on measurements and units found in contemporary engineering and science, it's easy for users to search for the values they need in order to replicate the properties of any real-world material, from sponge to wood to titanium and beyond. This cache was simulated within both Hulk's muscle and fat/skin passes so that the weight of the armour would affect the natural jiggle around Hulk's belly.

No More Waiting for Bakes

Last but not least, to bake all of the simulation work we used Ziva's Batch licenses, which are non-interactive versions of Ziva VFX that can render work without interrupting valuable license seats. With this, we could focus on the fat/skin pass as the muscles were baking. With animation, muscle simulation and the fat/skin setup all happening concurrently, we were able to save time on all fronts.

Additionally, we also used overnight bakes to see the fruits of our labour right away when we arrived the next morning. This was a highlight of using Ziva, as adding new animation didn't feel scary or risky. We didn't worry about crashing software, failed bakes or exploding anatomy.

Copy, Paste & Replicate

Within three days, our entire Hulk rig was complete. The mocap animation enabled lifelike movement, while the physically embedded simulation enabled highly performant secondary dynamics across every shot. Now that we had learned to use Ziva Anatomy Transfer tools, we knew we could scale our creature process and make impressive heroes in a matter of days.

Armed with this knowledge, we went to work on our next project. This just so happened to be Marvel's fifth anniversary video, which incorporated many of the existing characters from the game trailer but also starred the Watcher, a humanoid character with a comically large head. Since it was so easy to make additional characters with Ziva, we decided to take it for another spin and try to sim the Watcher using the Hulk's new anatomy. We literally just repeated the above workflow using the Hulk as the Source Mesh and the Watcher as the Target Mesh. I was sceptical if this would work, given how different these two assets appear. They are both bipedal, but the overall scales and body compositions are so entirely different. In the end, Ziva's warping tools made the transfer flawlessly. I was even able to improve and add unique details on the Watcher while still leveraging all of the quality work we completed on the Hulk.

For the Watcher, there is a critical scene where his calf muscles needed to excite in ways that Hulk's did not. However, the simple anatomy of Hulk didn't include some of the minor muscle groups we needed. So, I quickly modelled the new muscle segments, attached them to the calf and used Ziva's Cut, Copy, Paste tool to carry over all the existing muscle attributes onto the new tissues:

1. Select the existing tissue with the setup you want to copy.
2. Click the Ziva Transfer Menu > Cut.
3. Unselect the old tissue.
4. Select the new mesh object on which you want the attributes to be inherited.
5. Click the Ziva Transfer Menu > Paste.

Within seconds, the new mesh was turned into a tissue and all of the elements were interpolated smoothly. Even the Line of Action muscle excitation setup was carried over, so the muscles would naturally fire during appropriate times when the rig was animated. Being able to just warp anatomy and copy-and-paste entire setups is fantastic because it opens the doors for different layers of detail. You don't have to worry about your next project being incompatibly complex, because you can just add to what you have, any time you want. › ei

When Irene Pu saw Weta's Digital Tissue System VFX breakdown in 2012, she saw the possibility of pursuing a career making awesome creatures. When she was 14, she started playing around with Maya. Four years later, she graduated from the CG Masters School of 3D Animation & VFX and started her career animating for game cinematics at Goldtooth. She is currently Rigging/CFX Lead, and is responsible for many of the realistic creatures for Goldtooth's game cinematic trailers. In her free time, she likes playing with her two hamsters, making Commander decks, painting miniatures and making action figures.