

COMS30059 CGI Report

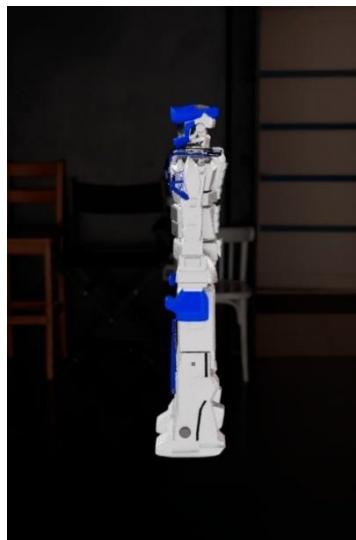
Yuxin Cui, go19297

This report is about the design process of my Olympoid character. It will introduce the design idea, some convenient skills for using maya, some mistakes I made and the lesson I learned. In the end of this report, there will be an evaluation about my works.

Character Design

This project creates a robotic boxing athlete character. I choose to animate a boxing athlete because I think boxing is an exciting sport. It is a competition of both strength and wise between two boxers. It examines agility and duration of people, showing their healthy body and strong willpower. Because I am a student registered as COMS30059, I am not required to render two characters. I choose to animate a daily training exercise of boxers.

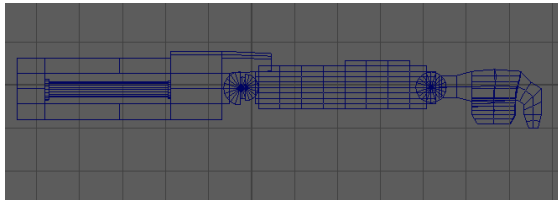
I want my robotic character shows features of boxing athlete, the boxing equipment, gloves and helmet, is indispensable. I also want the robot has some element of humankind, like heart, muscle and bones. So, a reacting core, some geometry shape or lines, and a spine was added. They are showed in the following figures. More details will be included in chapter model development.



Model Development

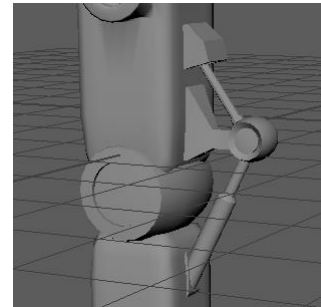
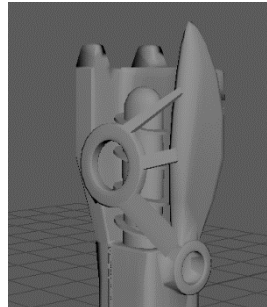
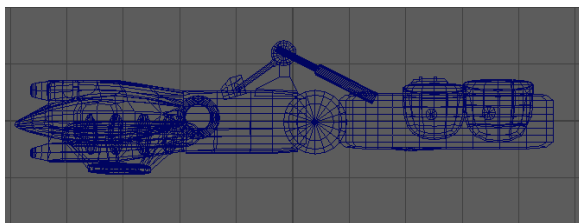
This chapter will begin with robot arms, legs, head then the body. I modelled them separately and combine them together in the final file. To follow the concept of modularity.

Arms are the most appealing part for a boxer. I build two style of arms and break the symmetry of the whole model. The right arm looks square and upright, which present the durable and simple power. In order to make it looks not too solid, I let the middle part of cuboid to be a pipe. To make

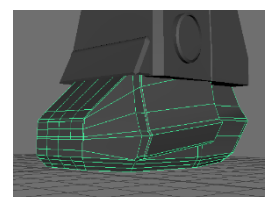
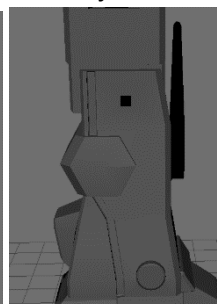
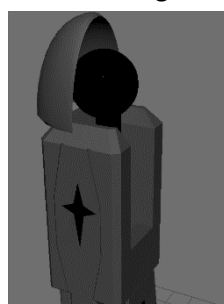
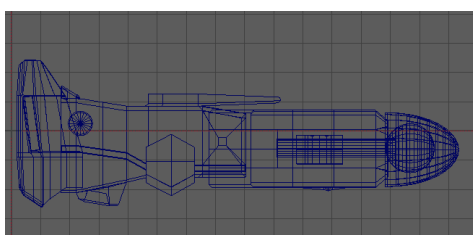


the right arm can defend incoming attack, I add an armour plate at elbow and shoulder. Finally, I add some decoration on the forearm and connect the arm with boxing glove. The boxing glove is modelled based on real reference.

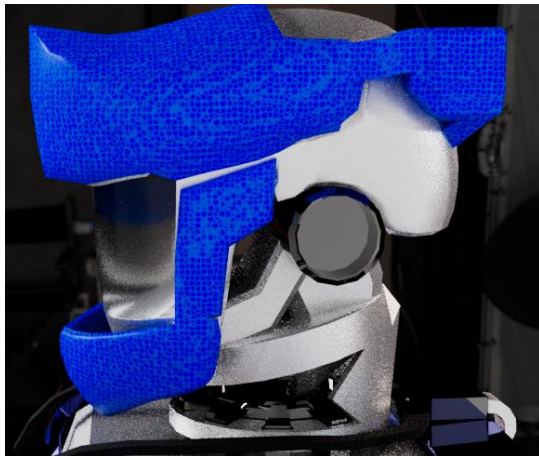
On the left arm, I want to add some sci-fi element on it. The rear arm has a cooling rod, which will emit blue light when it is working. There is some spear on the shoulder. At beginning, I used to add an exo-skeleton at the elbow part, but I remove it due to it becomes a hindrance when the arm rotating. There is also some decoration on the forearm and a boxing glove.



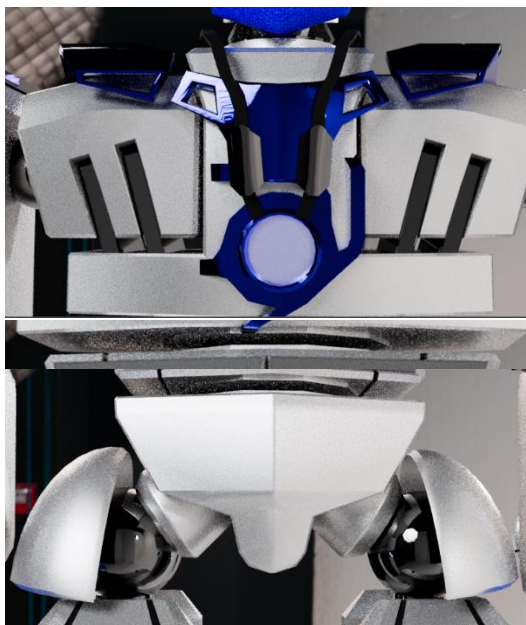
The legs are designed to be heavy and stable because usual robots are hard to maintain balance. The connection part between leg and body are a sphere and rod. The lines and hexagon on the leg are simulating muscles on the leg. There are some holes on the bottom of foot which intend to install some rocket booster. However, the flame effect needs to be added in the post-processing step, so I just leave the hole here. There are two handles on thighs which are just decoration.



The head has a boxing helmet, and the face of robot is a shiny glass screen. The ear is represented by a cylinder and neck is the combination of gears and polygons. I design the structure which is exposed to outside are intended to imply the head is a fragile part of boxing robots. The shape of head was created from a cube, I add more divisions and modify the vertices to get a rough shape. During the process of changing vertices, I use number 3 on keyboard to preview the shape after smoothing. When it reaches the shape I expected, I use smooth and get a high-poly model.



The body is made up of three parts: chest, belly, and hip. The chest has two detached parts which can move in two directions. This is designed because our shoulder's location will change when we do punch behaviour. When the shoulder moves forward, then it looks like arm is stretched a bit longer. I hope to compensate that hard surface cannot be applied to Disney animation principle through this way. Besides, I put some armour plate on the belly to simulate the muscle. In fact, I have an older



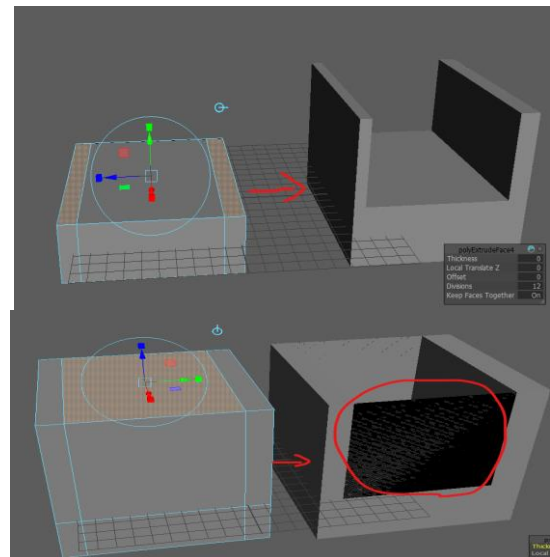
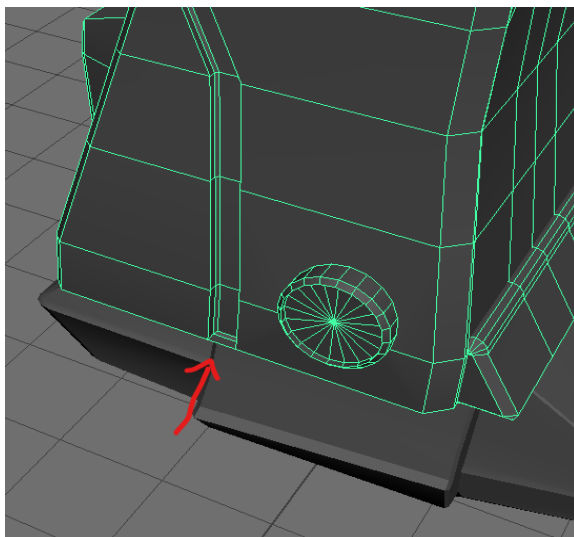
version of body. This body is one polygon which has no detached parts. I find the older version cannot deform when making the animation, so I make it looks like the current version.

There are some decorations on the body, a metal plate above the shoulder, a reacting core in the chest, and a spine on the back. The metal plate is designed to constrain the moving shoulder. It can help the shoulder not fly out when the robot does a jab or punch. The reacting core want to simulate the heart, there is some wires come from it to transfer energy to the whole body. It can emit blue light as well. This idea comes from a picture. The spine is made of many same units. I hope it could add a sense of cruel to the robot.

Modelling Skills

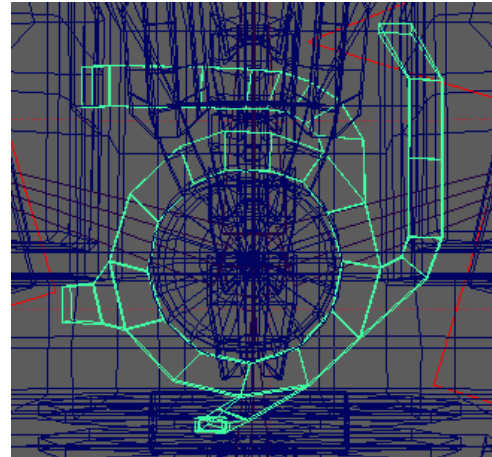
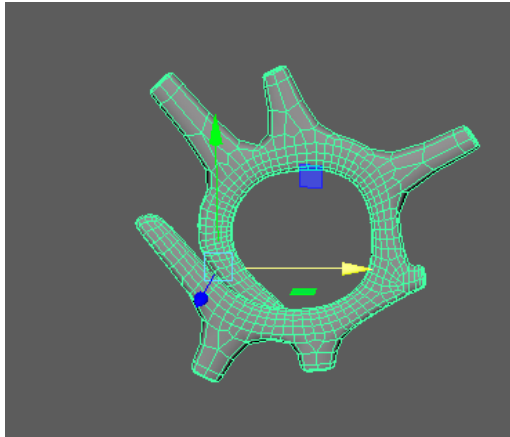
The following section will introduce some skills I used and some mistakes I made. These may be a common sense for experienced 3D modelling artists but still be valuable for the beginners of modelling.

When we want to make a hole on the model, we better use the bool operation in 'Mesh' of tool bar and then fix the model using method 'Bridge'. Sometimes using extrude inward to the model will leave a mesh face that hard to delete. More importantly, it may cause some functions like inserting edge loop or smoothing does not work. An alternative method is building model differently, we can leave the position of hole and extrude other places.



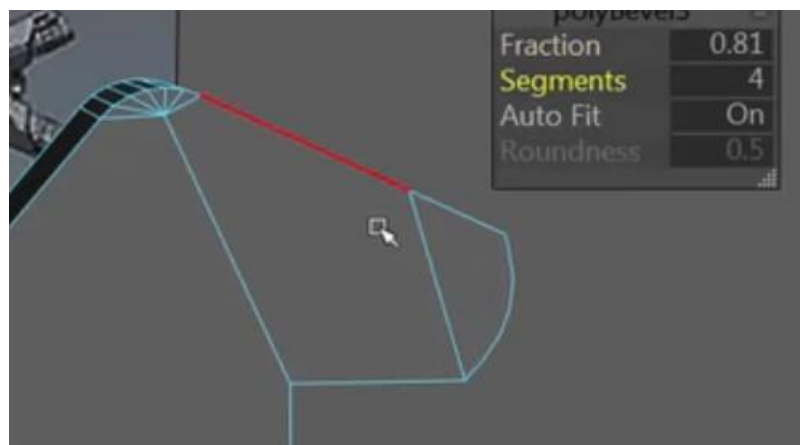
Multi-cut tool does a lot of favour for this project. It will help you find the mid-point when holding Shift and insert edge loop quickly when holding Ctrl on keyboard. It could also help you to divide a mesh face with more than 4 edge into many triangles and quadrilaterals. An interesting math knowledge is polygon with odd number of edges cannot be divided up by only quadrilaterals but even number of edges can.

Using NURBS edit point curve can draw you a desired outline quickly. When you have a reference, you can depict the image by inserting the reference into image plane. When you do not have the reference, you can draw it with the help of grid. Just holding 'X' on keyboard and the point will stick to the grid intersection. There are more choices which let EP points stick on different surface on the tool bar above.



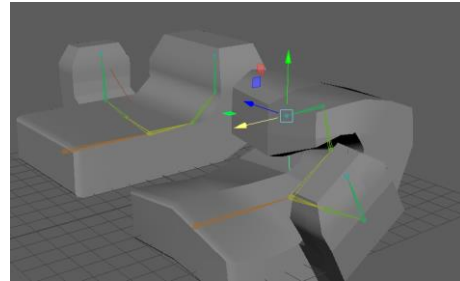
It makes your hard-surface model more realistic by using bevel. Although metal is hard and sharp in real life. There is no perfect right angle in most metal products. I use bevel on every sharp edge to smooth them. And the model without acute edges looks more real.

Another application of bevel is creating curve in polygon modelling. It would be easier to understand by looking the figures. Firstly, add a support point on model. Secondly, choose both vertex and the support point. Thirdly, use bevel and it generate a smooth curve. Curved faces generated by this method is more natural than modify them manually. And the support point can be safely deleted after this finish.



One mistake I have made is to combine each part by using bool union operation too early. For example, the star decoration on legs showed in figure. Once two model are union together and delete the history, it cannot be recovered anymore. I have to use 'detach' and 'separate' when I

want to assign them different materials. The correct method should be using group to contain them once they are in the desired position. The group can make sure they translate and scale together. And in case you want to change their position later, you can modify them as usual.



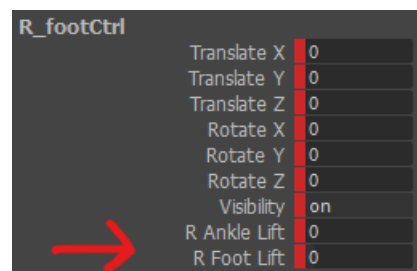
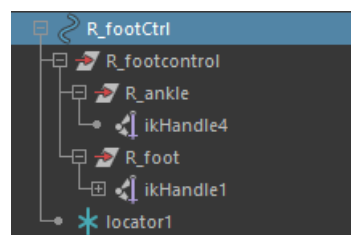
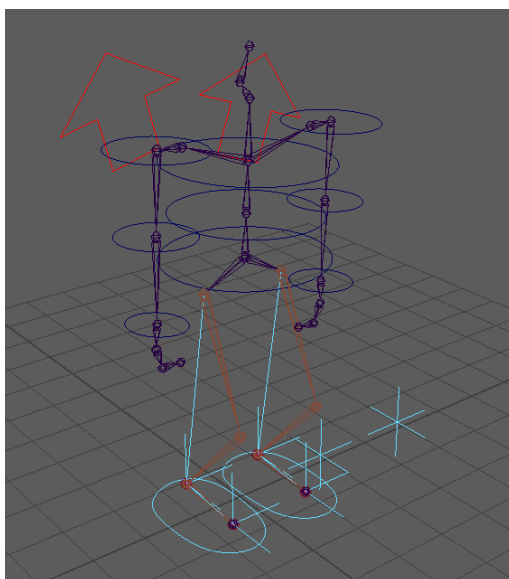
The boxing gloves are modelling by reference [1], I use NURBS edit point to draw the outline and then extrude the NURBS plane to object. And finally change the NURBS to polygon.

Animation Design

This chapter is about action design, rigging, shading and rendering.

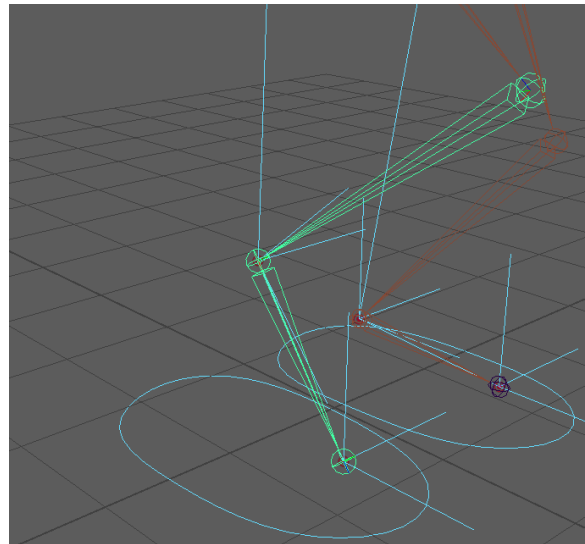
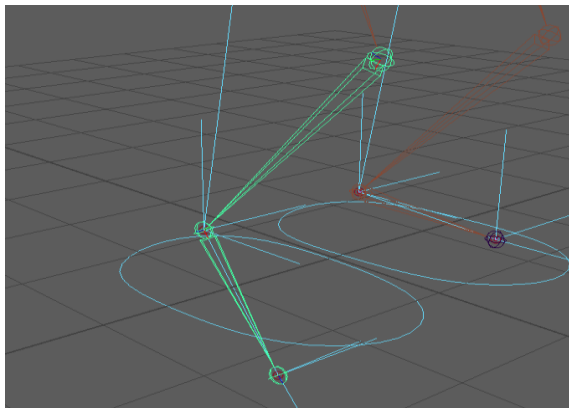
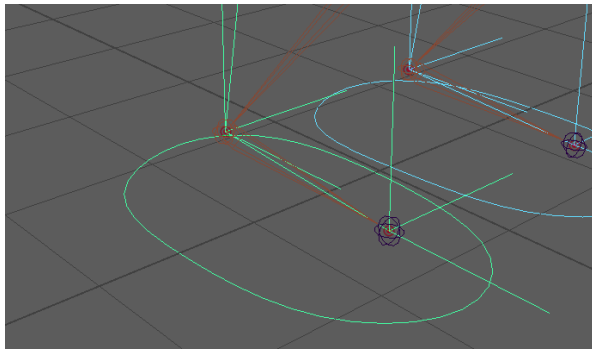
Rigging, Controller, and IK Handle

In order to bring life to Olympoid character, first thing is to create a set of skeletons for it. This can be achieved by creating joints easily, I keep the orientation of joints as the same with their direction. Then comes the most important step, setting controller. This step decides the efficiency of animation producing. I spend a bit of time on creating controller and it saves me more time when doing the animation. Basically, controllers are a bunch of NURBS circles that surrounded at each joint. The meaning of these circles is let you select the exact joint when you do the animation, so you will not click the polygons by mistakes. I only use IK handles to control the motion of legs. And there is a controller for IK handle as well.



One skill for creating the controller is to keep the circle has 0 transformation. I do this with the help of group relationship. I group the circle as soon as I create them, then moving the group to desired position, must stick to joint. During moving, the group will take all the transformation and the property of circle keeps unchanged. After the group reach the target position, must remember to freeze transformation and delete history. Otherwise, it may have unexpected result later. Only parent the group to joint at higher hierarchy after all. So, the controller will move with joint together. Finally, we can add constrain between controller and joint. If it only control rotation, use orient constrain. If it controls the transformation, use parent constrain. I also add a pole constrain on the knee. To turn the direction of knee for better action. By the way, a rigging should be bind to model after finishing the controller to avoid it be difficult to changed latter.

An advanced skill I use is to add attributes in foot controller for setting the driven key. I key the ankle lift action and foot lift action with the new attributes because they are common action happened in the animation. But what needs to be notice is after setting the driven key. The key frame animation can only be done by changing the driven key value.



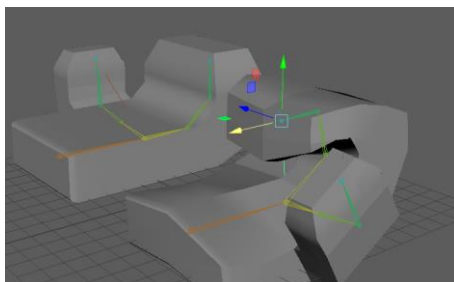
Animation

When setting the key frame animation, there are two ways to do it. One is using less keyframe and adjust the keyframe in graph editor. The other is to manually insert more keyframes to achieve it reach some points early or slowly. I prefer the later method, which can keep my thinking

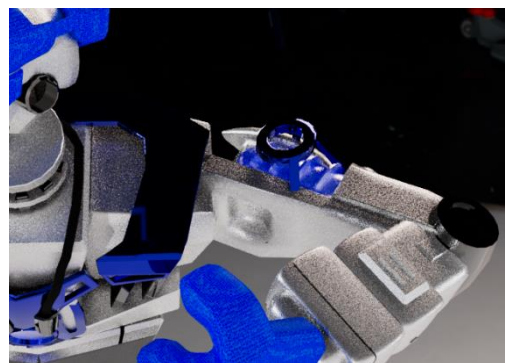
continuously when animate the action intuitively. And I will adjust some property in graph editor after I finish the whole process. For example, I delete some unwanted rotate of arm when my robot punching and slow the punch at the start step to represent an acceleration.

The momentum can be showed by insert a key frame with larger move before the target key frame. So, the effect will be like the arm has a momentum and keeps moving after robot recovered from one punch.

Hard surface model is hard to use deformation to follow Disney principle. I make the shoulder movable to compensate this. What is more, I make the boxing gloves can deform by binding skin between the model and joints. The result is shown in figure.



One annoying part is the model go through itself. This usually happens around the joint. So, it needs to leave some space at elbow and knee when modelling. One pity of this project is I am not good at drawing, so most parts of model use material, only add texture of picture of school logo and Olympic logo.



Camera movement also plays an important role in the animation. The camera is a storyteller of a film. First, the camera gives a front view of robot. And the robot starts doing the warmup action. Then the camera rotates around the robot to give audience a multi-view presentation of robot body. In the meanwhile, boxer's body starts lean forward shows it is ready for a fight. A left jab and right punch follow the previous behaviour seamlessly. After this, the boxer starts to move forward with caution, and the camera shows a front view of this scene, clipped from last position. Suddenly, the boxer attack, begin with an up punch and then it swings to give a series of hits. Here the atmosphere is heating to the climax by those combos. Camera gives a view of right leg at this point, it kicks the ground, camera show the side body, the waist rotates, and a heavy right punch is shoot. Finally, the

boxer steps back, return to its original position, and the spine recovered from lean forward state to a straight.

My favourite camera in this video is the last few seconds. The robot steps the ground and then give a heavy punch.



I design the animation by my imagination of a boxer's exercise, inspired by the video of Mike Tyson's training [3]. For the specific action, I referenced from a French boxing coach's tutorial video. He shows the correct pace of a boxer in that video [4].

Shader and Lighting Design

The body of robot is mainly composed of white and blue metal. The white metal looks matte, and the blue metal looks glossy and reflective. The face of robot is a transparent grey glass and the joints of robot use dark grey reflective material. Some bump areas use black to represent shadow. The armour plate on elbow and belly has some noise on it. And the reactor on shoulder and chest has the emission attribute make them emit blue light.



Lighting in this project comes mainly from the HDRI [2], and I add an ambient light to adjust the intensity of overall lighting.

Evaluation and Future Work

The joints of model like shoulders and knees are a problem when I do the animation. Some punches have a large motion that break the connection between shoulder and arm. This is not supposed to be happened in real life. The swing motion of robot in 7-8 second underreaching my expectation. It is not as powerful as I thought. If there is more time left, I may build a more complex model, with more decoration on the body, take the place near joints into account, and possibly add a set of exo-skeletons at some joints. For the animation, I will make the move more robotic by slow some action, just like the move is made up by the combination of many stepper-motors. What is more, I will key frame the emission attribute of reactor in the chest. Currently, the light from reactor is not obvious, but this is also because the scene is in the day and the light from environment is too strong.

Reference

[1] Boxing glove: <https://www.decathlon.com/products/beginners-boxing-gloves-bg-100?/>

[2] HDRI Spaichingen Hill: https://polyhaven.com/a/spaichingen_hill/

Animation:

[3] Boxing pace tutorial: https://www.bilibili.com/video/BV1WY411j7w5?share_source=copy_web/

[4] Mike Tyson training video:

https://www.bilibili.com/video/BV1d4411E7rL?share_source=copy_web/