

Final Tank Track Simulator Manual

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1.The working principle of this Track Simulator

First of all, when creating tank model ,the tank's tracks are the skin which were binded with wheel bones,and each wheel bone's position is the same as its corresponding wheel model's position.

When game is running, each wheel collider generates the displacement relative to tank's vertical direction, then we record each wheel collider's current position, assigning this position information to its corresponding wheel model and wheel bone,that is to say, each wheel model's position and wheel bone's position are always the same as their corresponding wheel collider's position.

As we just mentioned in the beginning,the track skin is binded with wheel bones,when a wheel bone is generate displacement relative to tank's vertical direction, corresponding part of the skin which effected by this wheel bone will generate deformation .

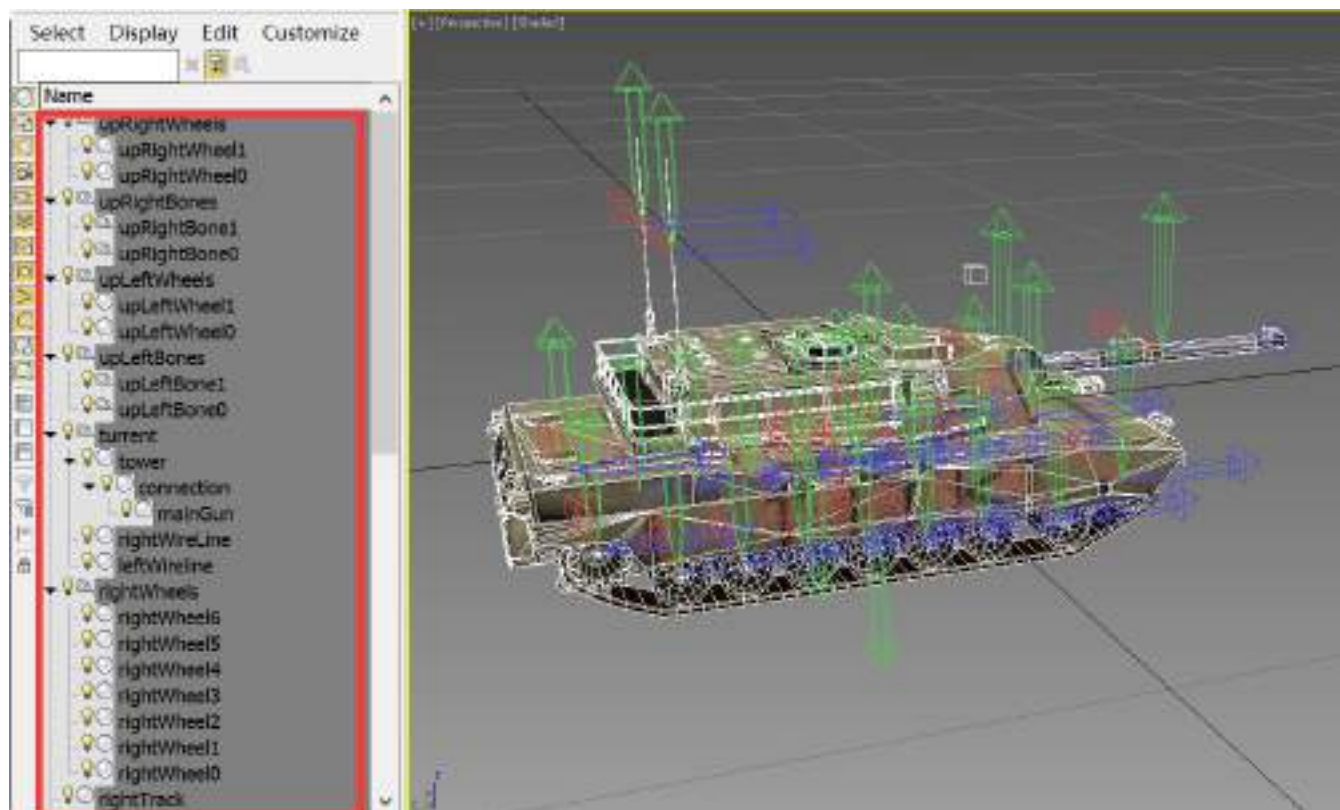
As far as the rotation of wheel model, we calculate wheel colliders' average rotation speed on one side of the tank,and applied this rotation speed to each wheel model's rotation on this side of the tank.

As far as the rotation of tank track when tank is moving, in fact, is shifting the track texture Constantly. we calculate the offset speed of track's texture according to wheel colliders' average rotation speed,then assign the offset speed to this track material's texture.

2. What tank model is suitable for this Track Simulator, and how do we bind bones for tank tracks to make tank models available to this Track Simulator?

Initially, The tank model which is available to this Track Simulator, must be properly separated from each other, that is to say, each wheel is a separated submodel, and the track on each side is also a separated submodel.

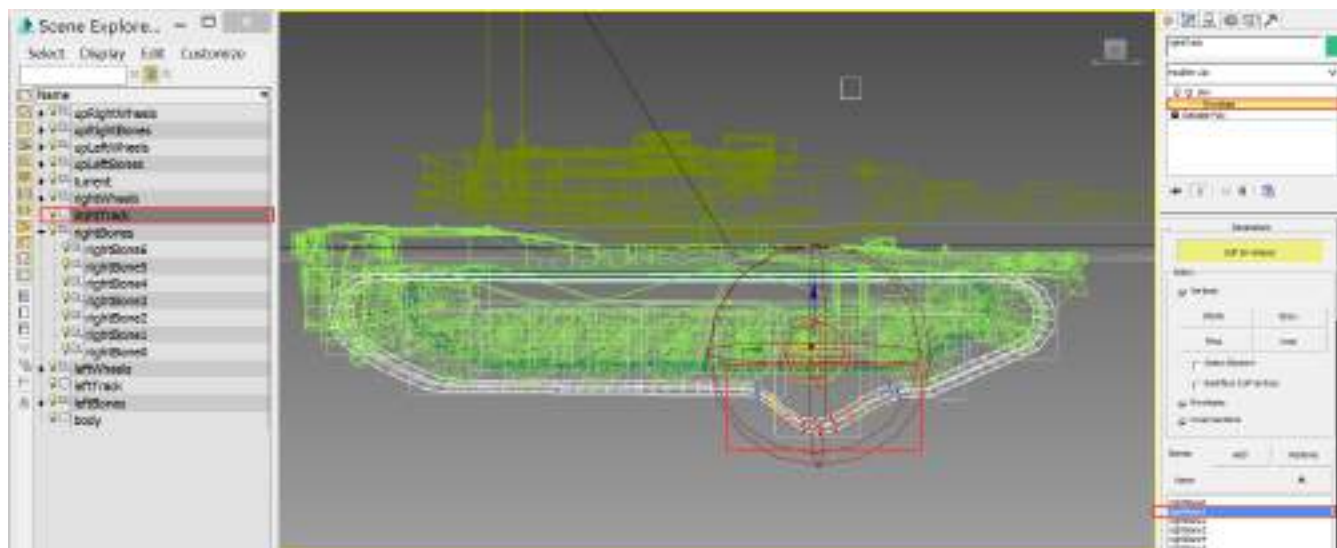
Further more, each separated submodel's axis should be set correctly.



Additionally, each track's mesh must be the skin mesh, and the wheel bones have been created at their corresponding wheel model's position, in other words, the position of each wheel bone which has been created must be exactly the same as its corresponding wheel model's position.



Finally, the weight value of the skin which effected by corresponding wheel bone should be adjusted properly.



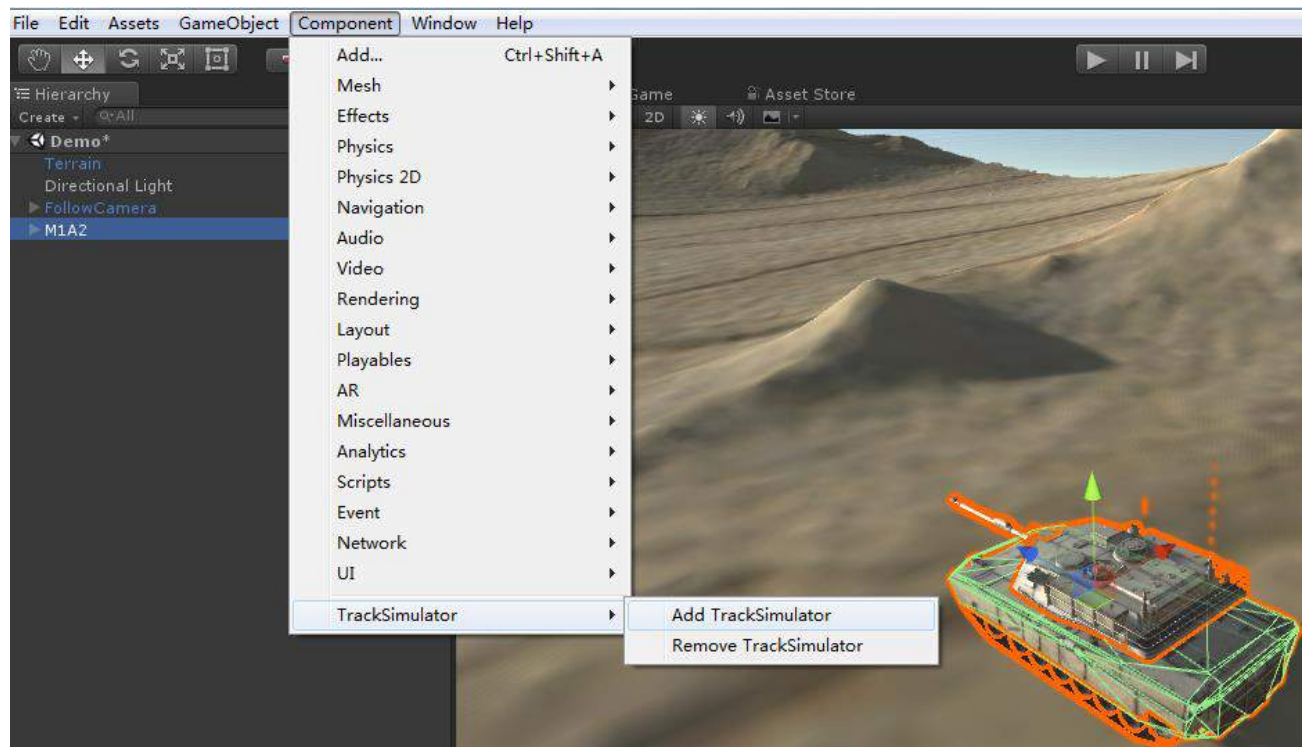
3.The introduction about each configuration interface of the track simulator component

(1).Adding or removing the Track Simulator component for the tank.

There are two options which were located in the top menu bar:

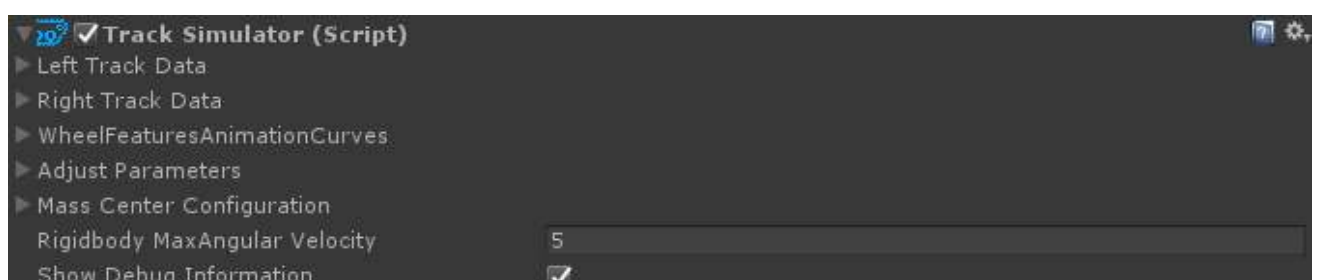
Component/TrackSimulator/Add TrackSimulator ,

Component/TrackSimulator/Remove TrackSimulator.



When you select a tank in the view of hierarch, Clicking *Add TrackSimulator* option , the track simulator component will be added to this tank.

When the track simulator has been added to your tank,Clicking *Remove TrackSimulator* option , the track simulator component will be remove from this tank.



(2). Configuration interface of the track data

This configuration interface is used for configuring wheel models, wheel bones, creating wheel colliders according to their corresponding wheel model's position, and configuring track skinnedMeshRenderer etc.

We take the *Left Track Data's* configuration interface as an example.

① The area named *UpperWheelDataArray* is used for displaying and configuring the wheels which are located in the upper position of the track.

The property named *Wheel Model* represents the transform component of wheel model;

The blue button named *Add Upper Wheel Data* which is located in the bottom of this area is used for adding a row of new *UpperWheelData's* instance.

② The area named *SuspendedWheelDataArray* is used for displaying and configuring the wheels which are located in the lower position of the track.

The property named *Wheel Model* represents the transform component of wheel model;

The property named *Wheel Bone* represents the transform component of wheel bone;

The green button named *Created WheelCollider* is used for creating the gameobject which will be added the wheel collider component, and initializing the parameters of wheel collider component. (when the wheel collider has been created successfully, the GUI of the green button named *Created WheelCollider* will be changed into a property named *Wheel Collider*, it will start to display the wheelCollider which has been created);

The red button named *X* which is located in the right side of each row is used for deleting the corresponding *SuspendedWheelData* instance, and destroying the corresponding wheel collider which has been created;

The blue button named *Add Suspended Wheel Data* which is located in the bottom of *SuspendedWheelDataArray's* area is used for adding a row of new instance of *SuspendedWheelData*.

③ The area named *Track SkinnedMeshRender* is used for configuring the skin of the track

The property *Track SkinnedMeshRender* displays the *SkinnedMeshRender* component of left track;

The red button named *Remove SkinnedMeshRender* which is located in the bottom of this area is used for removing the current *SkinnedMeshRender*

Track Simulator (Script)

Left Track Data

UpperWheelDataArray:

UpperWheelData 0: ✕

Wheel Model ○

UpperWheelData 1: ✕

Wheel Model ○

Add Upper Wheel Data

SuspendedWheelDataArray:

SuspendedWheelData 0: ✕

Wheel Model ○ Wheel Bone ○ Wheel Collider leftWheel ○

SuspendedWheelData 1: ✕

Wheel Model ○ Wheel Bone ○ Wheel Collider leftWheel ○

SuspendedWheelData 2: ✕

Wheel Model ○ Wheel Bone ○ Wheel Collider leftWheel ○

SuspendedWheelData 3: ✕

Wheel Model ○ Wheel Bone ○

SuspendedWheelData 4: ✕

Wheel Model ○ Wheel Bone ○

Add Suspended Wheel Data

Track SkinnedMeshRenderer:

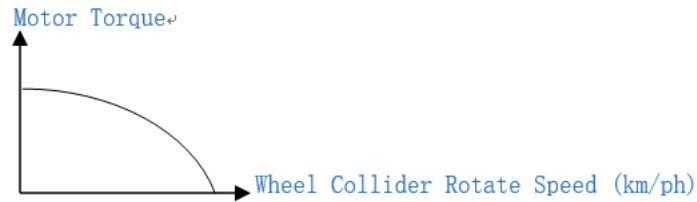
Track SkinnedMeshRenderer ○

Remove Track SkinnedMeshRenderer

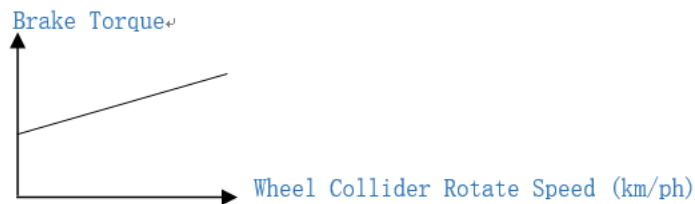
(3). The configuration interface of wheel collider's features curve

This configuration interface is used for configuring the features curve of the wheel collider:

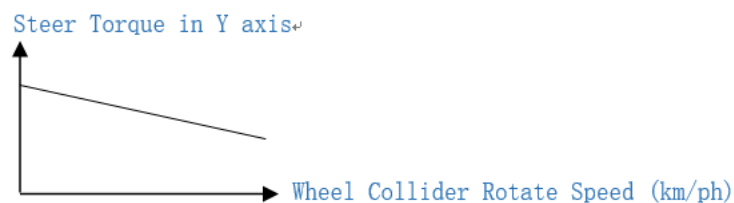
The animation curve named *SingleWheelMotorAnimationCurve* represents the relationship between the rotation speed of the wheel collider and the motor torque of the wheel collider



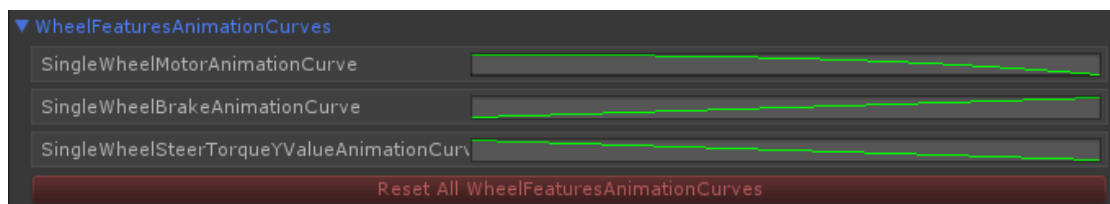
The animation curve named *SingleWheelBrakeAnimationCurve* represents the relationship between the rotation speed of the wheel collider and the brake torque of the wheel collider



The animation curve named *SingleWheeSteerTorqueYAnimationCurve* represents the relationship between the rotation speed of the wheel collider and the steer torque that will apply to the Y axis of tank's rigidbody



The red button named *Reset All WheelFeaturesAnimationCurves* is used for resetting these animation curve's shape according to the default setting in the custom editor script



(4).The configuration interface of correcting the track performance

When tank has been set up,if you find the offset direction of the wheel models and wheel bones is wrong,Or the rotation axis of the wheel model is not correct,or the offset direction of the track texture is mistake,we should adjust the parameters of this configuration interface to make the performance of tank's track become correct

① In the area which named *Wheel And Bone Transfrom Offset Configuration*:

The property named *OffsetDirection* is used for configuring the offset direction of wheel models and wheel bones,this offset direction must be on a certain axis of the wheel collider's gameobject: the x axis of the wheel collider's gameobject, the y axis of the wheel collider's gameobject,or the the z axis of the wheel collider's gameobject.

The property named *InverseOffsetDirection* is used for inversing the current offset direction of each wheel model and wheel bone.for example,if current offset direction of each wheel model and wheel bone is the Y axis of their corresponding wheel collider's gameobject, and the property named *OffsetDirection* is not checked,then the offset direction of each wheel model and wheel bone will not be changed.otherwise, the property named *OffsetDirection* is checked,then the offset direction of each wheel model and wheel bone is changed into the -Y axis of their corresponding wheel collider's gameobject,in other words,the offset axis is reversed.

The property named *OffsetValue* represents the size of the offset value along the offset direction of each wheel model and wheel bone.

② The area named *Wheel Rotate Configuration* is used for configuring the rotation axis of the wheel model.

The property named *Rotate Axis* is used for selecting a certain axis of wheel model for wheel model to rotate around itself.

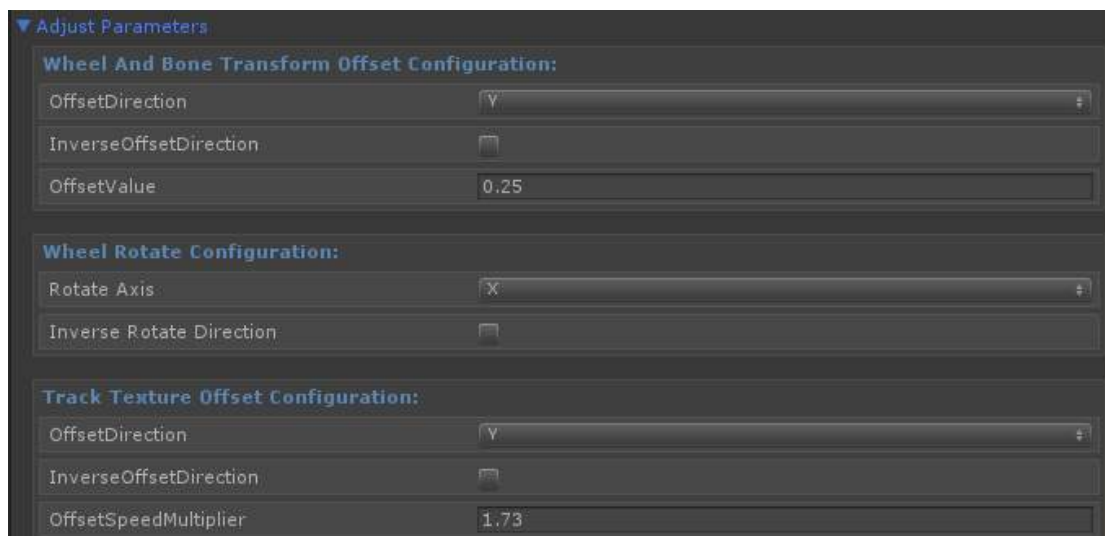
The property named *Inverse Rotate Direction* is used for inversing the current rotate axis of each wheel model,for example, if current rotate axis of each wheel is its X axis,when the property named *Inverse Rotate Direction* is not checked,the rotate axis of each wheel is not changed,otherwise, the property named *Inverse Rotate Direction* is checked,then the rotate axis of each wheel is changed into its -X axis,that is to say,the rotate axis is inversed

③ The area named *Track Texture Offset Configuration* is used for configuring the offset direction and offset speed of the track texture.

The property named `OffsetDirection` is used for configuring the offset direction of the track texture in the x direction or the y direction.

The property named `inverseOffsetDirection` is used for inverting current offset direction. For example, when the track texture current offset direction is x direction, and the property named `inverseOffsetDirection` is not checked, the track texture offset direction will not be changed, otherwise, the property named `inverseOffsetDirection` is checked, then the track texture offset direction is $-X$ direction, that is to say, the offset direction is reversed.

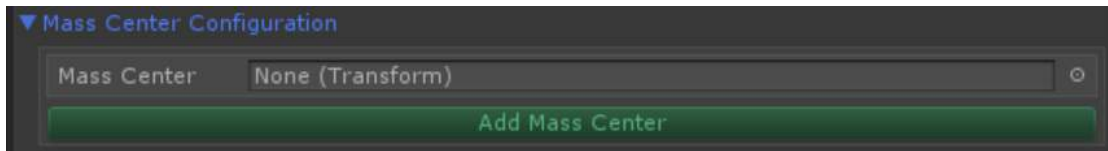
The property named `OffsetSpeedMultiplier` represents the speed of track texture's offset. When the offset speed of the track's texture is not in harmony with the rotation speed of the wheel, by adjusting this parameter to make the offset speed of the track's texture is in harmony with the rotation speed of the wheel as much as possible.



(5). The configuration interface of tank's mass center

This configuration interface is used for configuring the mass center of the tank .

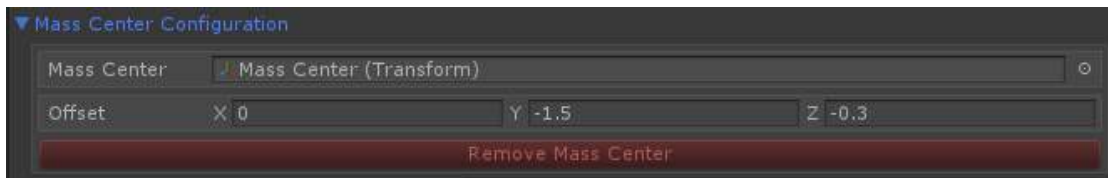
Click the green button named *Add Mass Center*,it will automatically created a gameobject named *Mass Center* under the root gameobject of the tank, this gameobject 's position represents the position of tank's mass center.and its localPosition will be initialized to (0.0f,0.0f,0.0f).



When the gameobject which represents the mass center has been created,the GUI of this area will be chanced.

The field named Offset is used for adjusting the gameobject's local position which represents the mass center of the tank relative to the root gameobject of the tank.

The red button named *Remove Mass Center* is used for removing the gameobject which represents the mass center, and destroying this gameobject



(6). The configuration interface of tank rigidbody's max angular velocity

This property is configuring the max angular velocity of this tank



(7). The configuration interface of Debug Information's switch

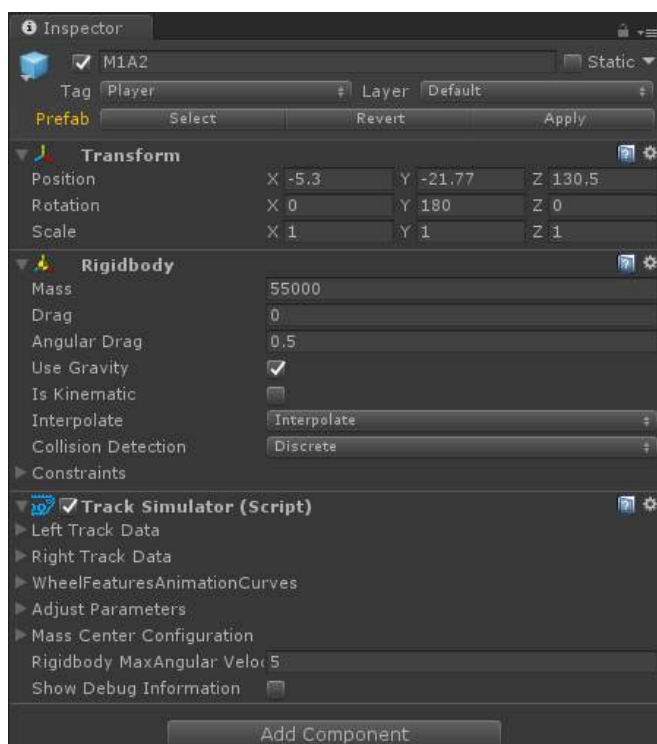
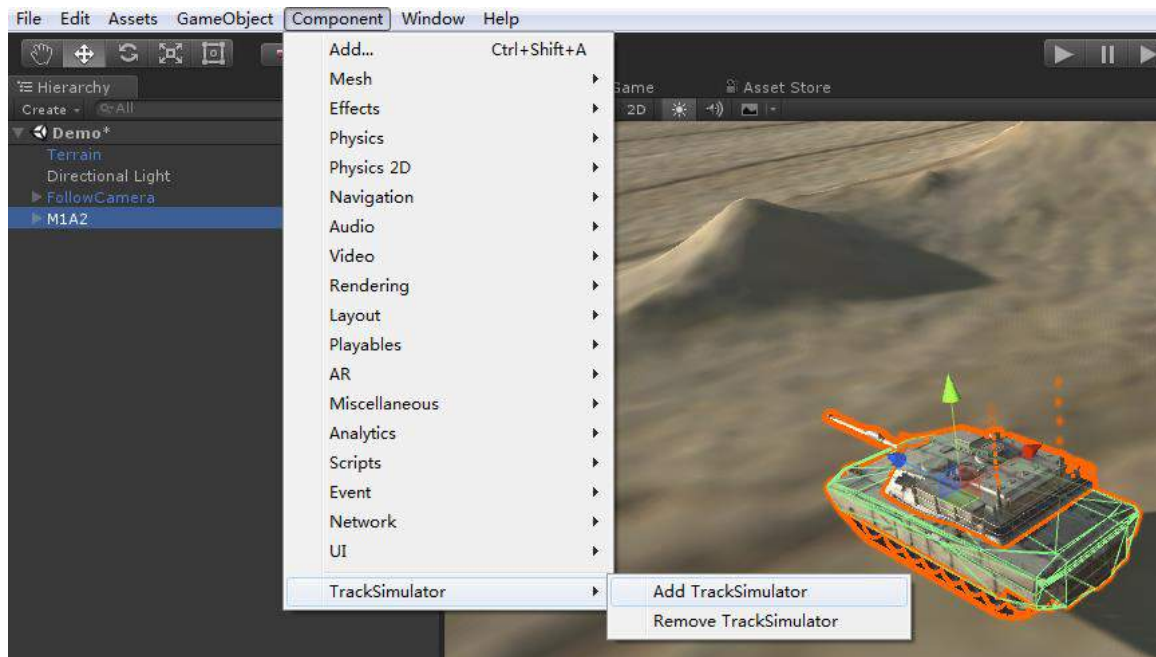
When this property is selected,the screen will display the moving speed of the tank,etc.



4.Using this Track Simulator to set up a new tank

(1)Adding Track Simulator component to tank's root gameobject

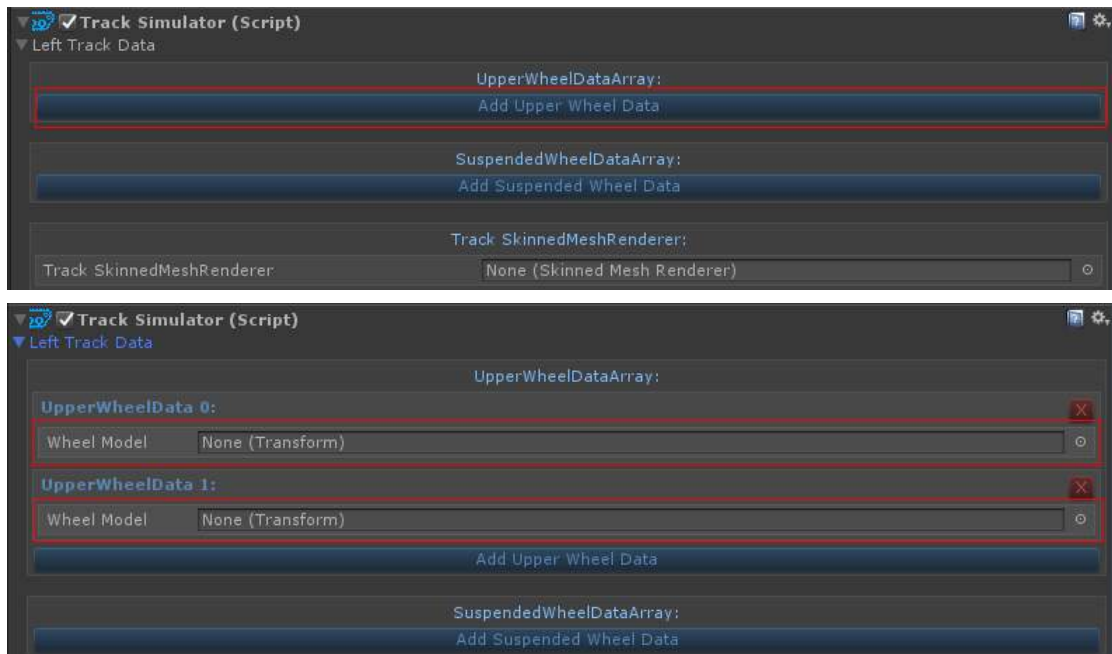
Selected the root gameobject of the tank,then click the option located in menu bar: Component/TrackSimulator/Add TrackSimulator, to add the Track Simulator component to tank.



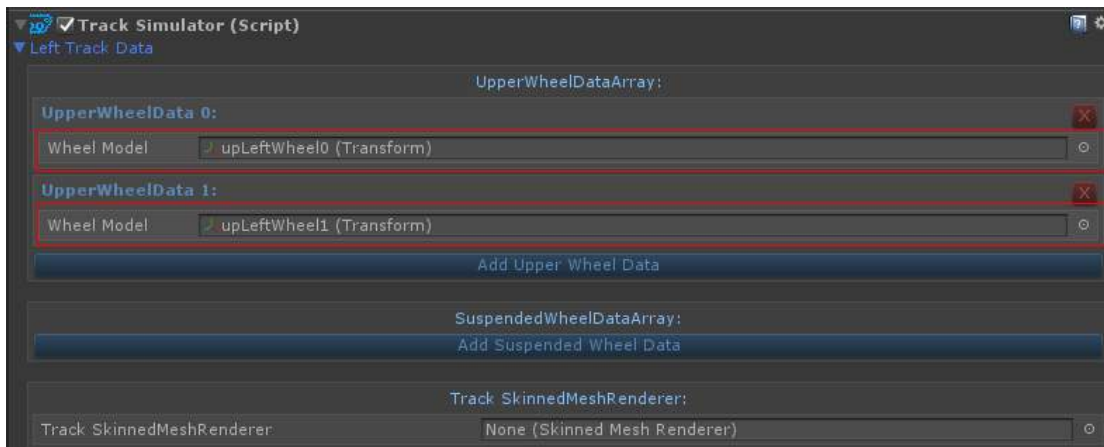
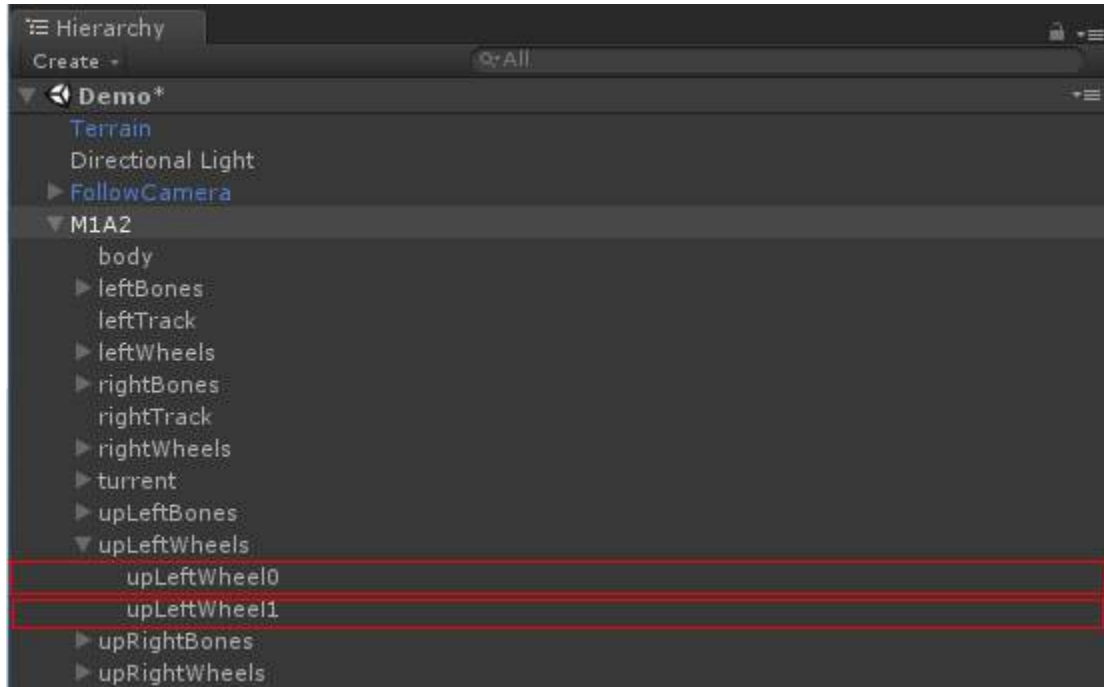
(2)Configuring the configuration Interface named Left Track Data and Right Track Data

①Configuring the area named *Upper Wheel Data Array*:

Click the blue button named *Add Upper Wheel Data* to create two rows of UpperWheelData's instance.They are the UpperWheelData's instance named UpperWheelData0 and UpperWheelData 1

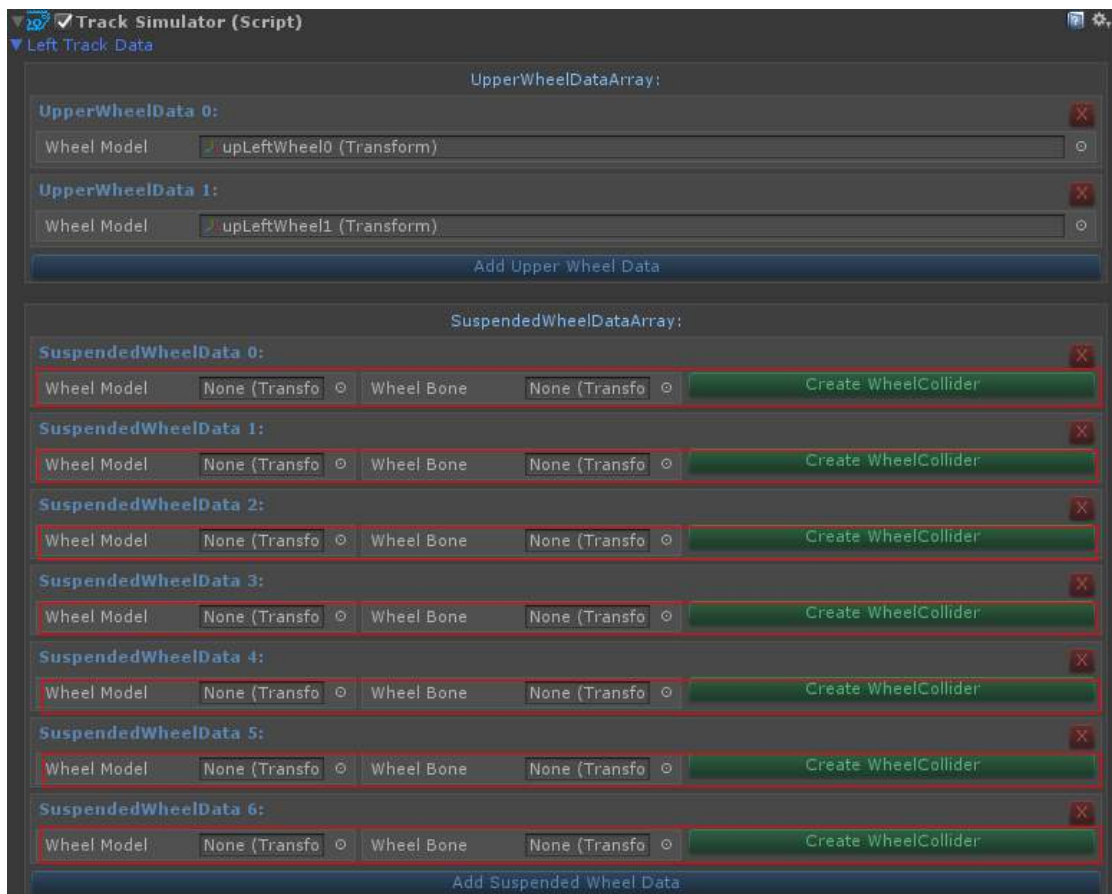
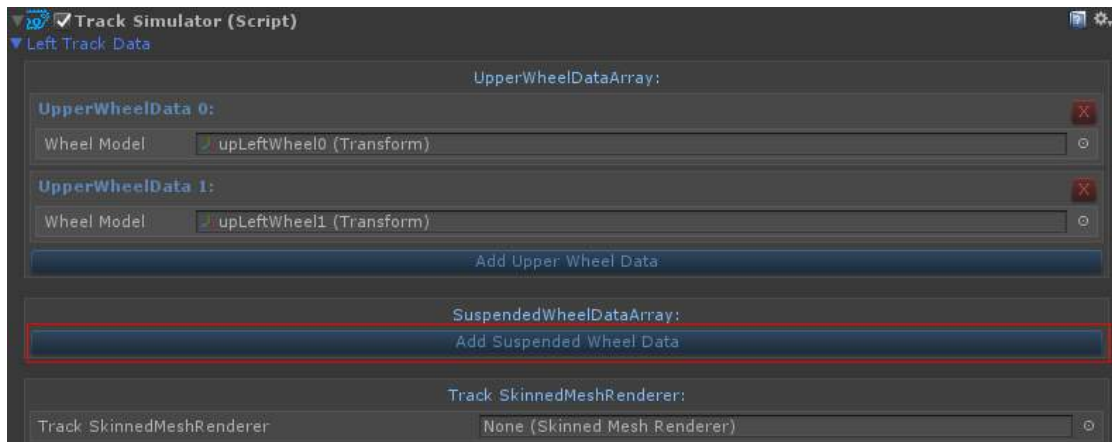


In the view of Hierarchy, separately dragging the wheels named upLeftWheel0 and upLeftWheel1 which are located in the upper position of the left track to the UpperWheelData 0's field named Wheel Model and the UpperWheelData 1's field named Wheel Model

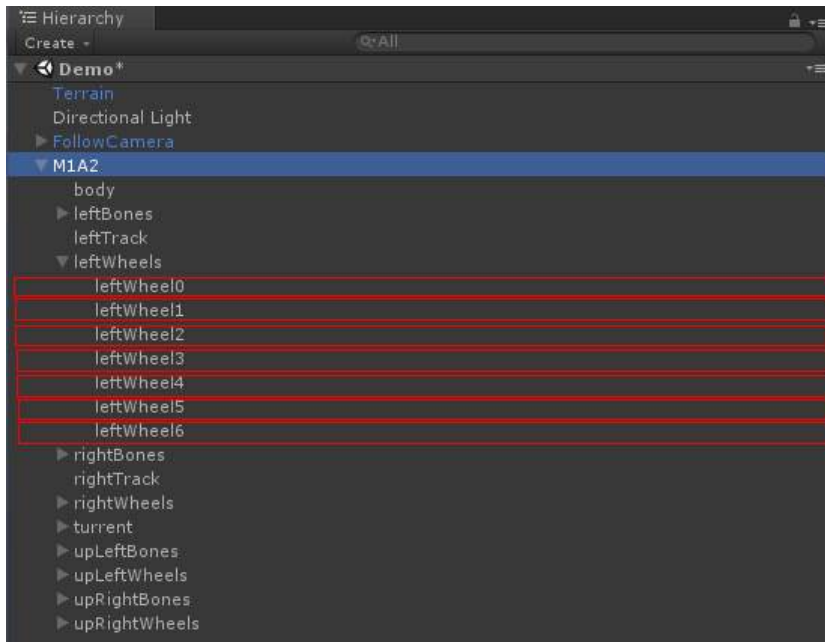


② Configuring the area named *Suspended Wheel Data Array*:

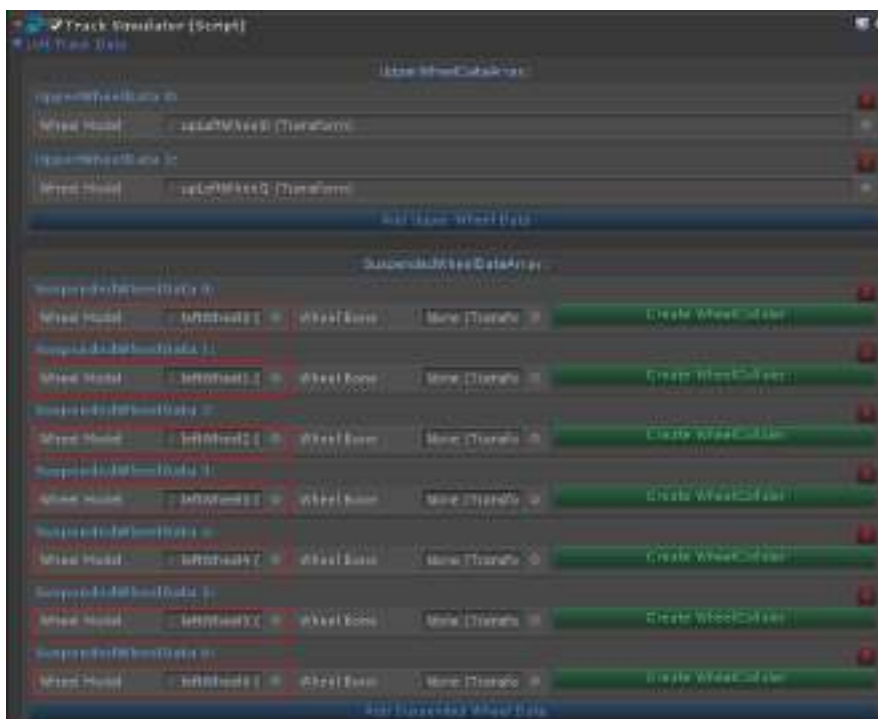
Clicking the blue button named *Add Suspended Wheel Data* to create 7 rows of new *SuspendedWheelData*'s instance, their name are *SuspendedWheel 0* , *SuspendedWheel 1* , *SuspendedWheel 2*, *SuspendedWheel 3*, *SuspendedWheel 4* *SuspendedWheel 5*, and *SuspendedWheel 6*.



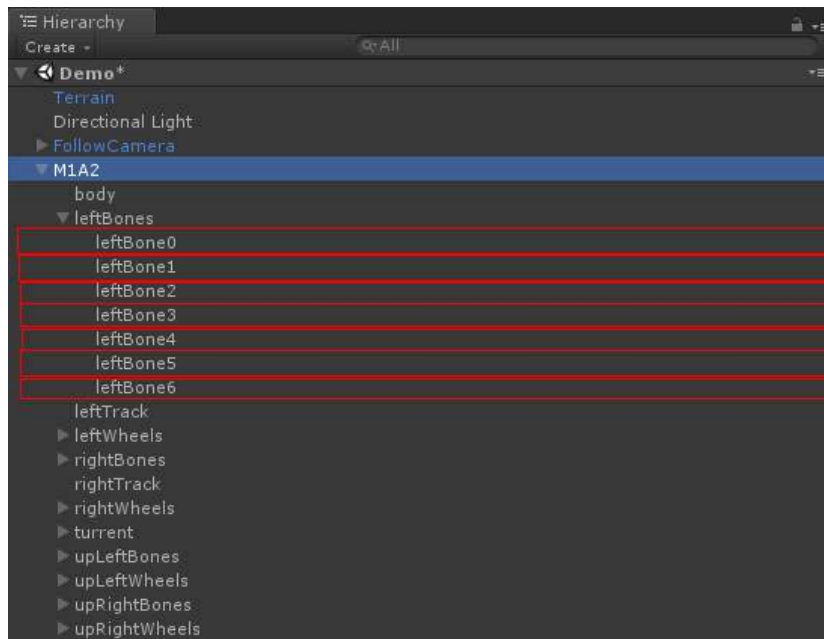
In the view of Hierarchy,selected the wheel models which were located in the lower position of the left track,their name are leftWheel0,leftWheel1, leftWheel2, leftWheel3,leftWheel4, leftWheel5 , and leftWheel6



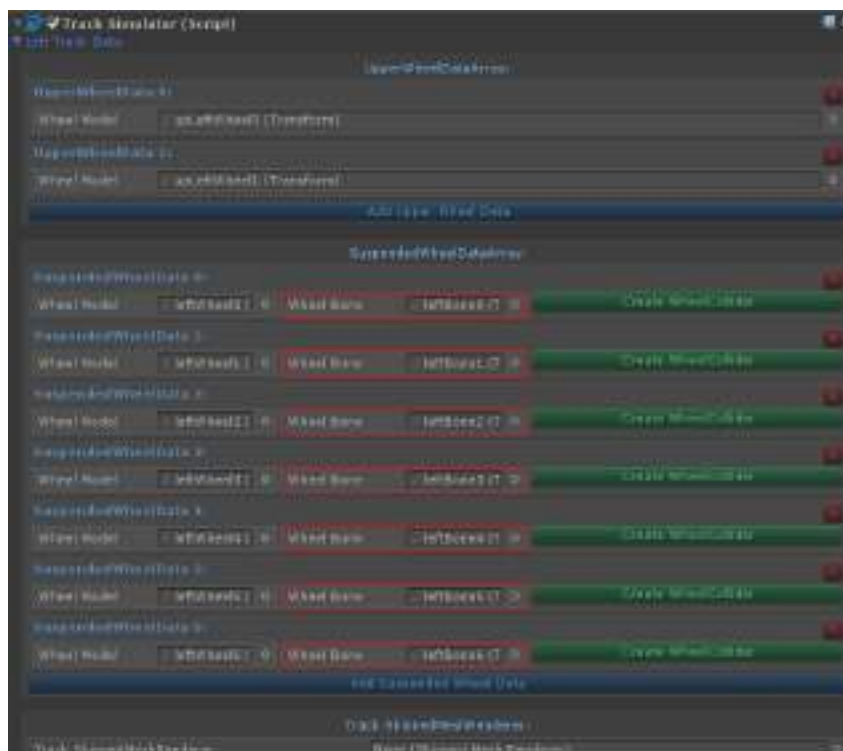
Separately dragging them to the field:
 SuspendedWheel 0 -> Wheel Model,
 SuspendedWheel 1 -> Wheel Model,
 SuspendedWheel 2 -> Wheel Model,
 SuspendedWheel 3 -> Wheel Model,
 SuspendedWheel 4 -> Wheel Model,
 SuspendedWheel 5 -> Wheel Model,
 SuspendedWheel 6 -> Wheel Model.



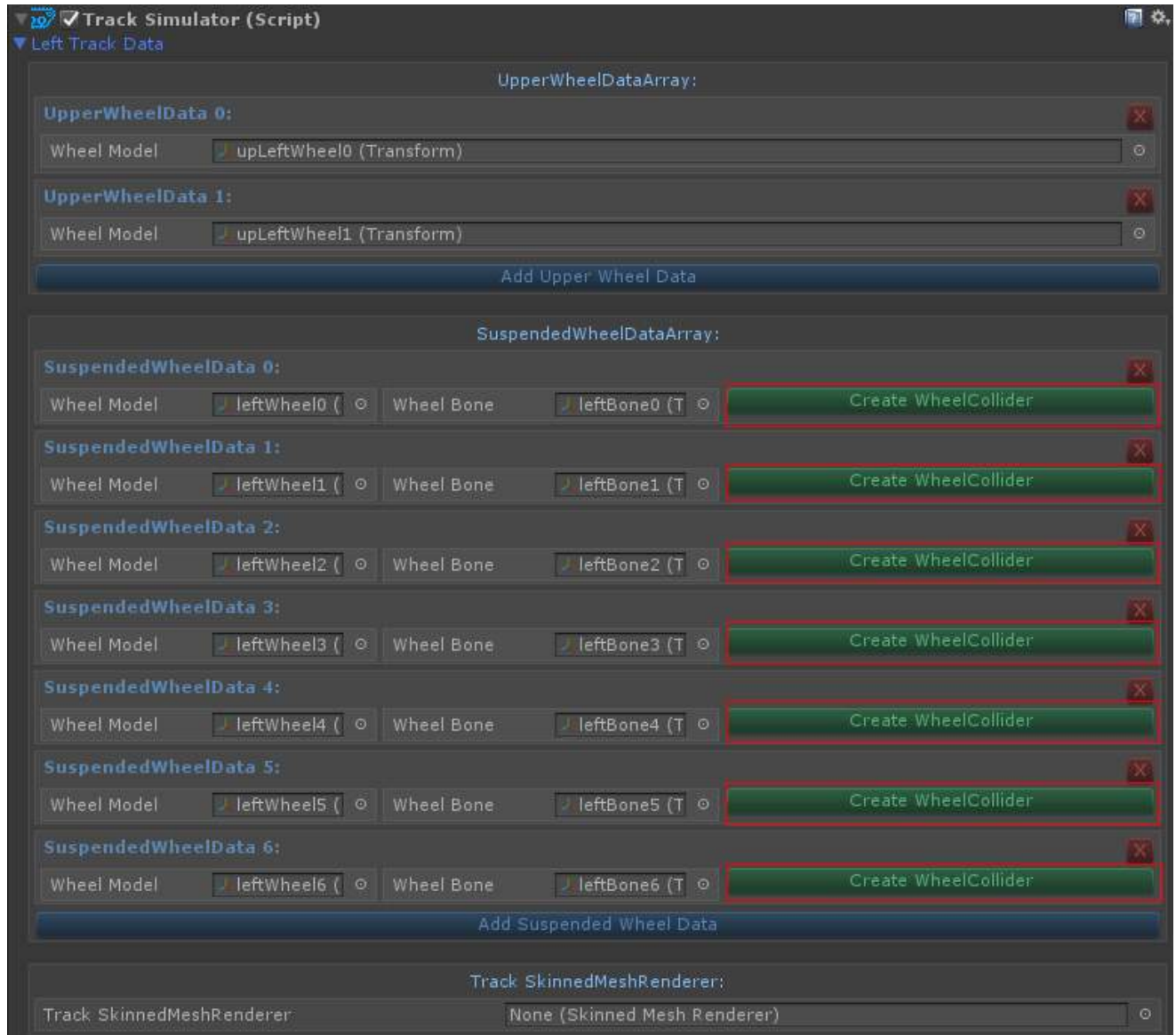
In the view of Hierarchy, selected the wheel bones which were located in the lower position of the left track, their name are leftBone0, leftBone1, leftBone2, leftBone3, leftBone4, leftBone5 and leftBone6.



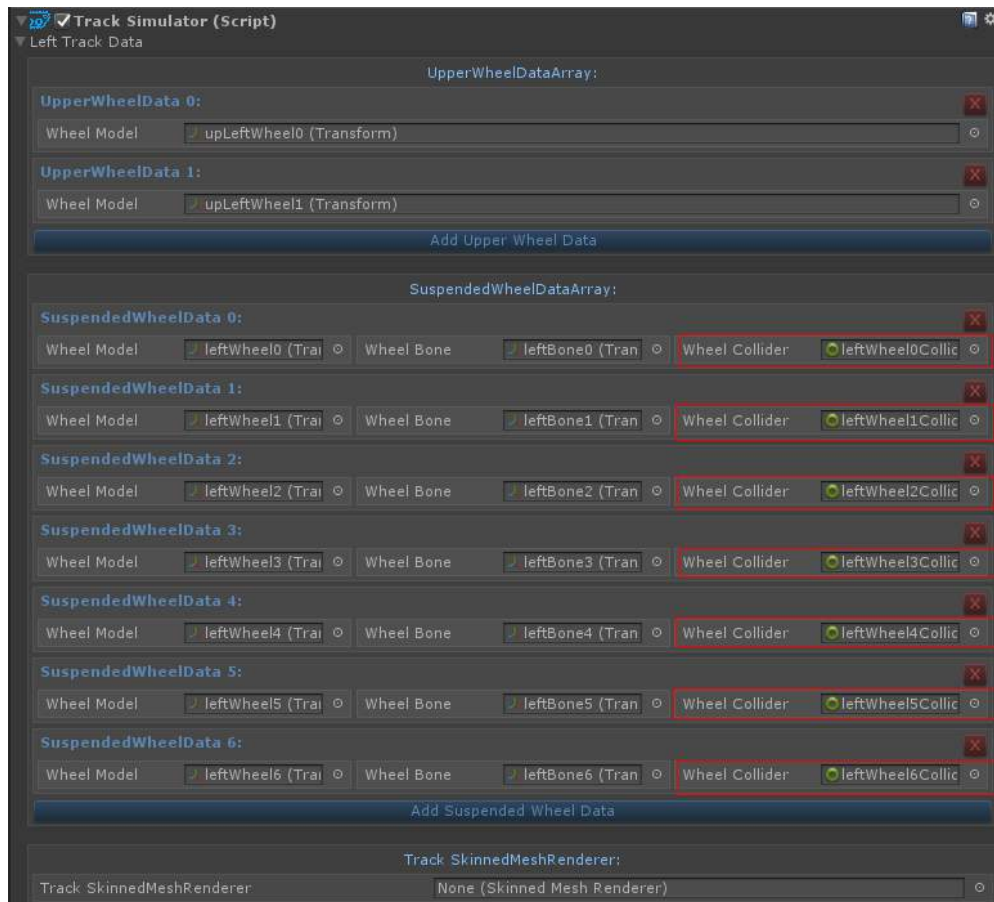
Separately dragging them to the field SuspendedWheel 0 -> Wheel Model, SuspendedWheel 1 -> Wheel Bone, SuspendedWheel 2 -> Wheel Bone, SuspendedWheel 3 -> Wheel Bone, SuspendedWheel 4 -> Wheel Bone, SuspendedWheel 5 -> Wheel Bone, SuspendedWheel 6 -> Wheel Bone.



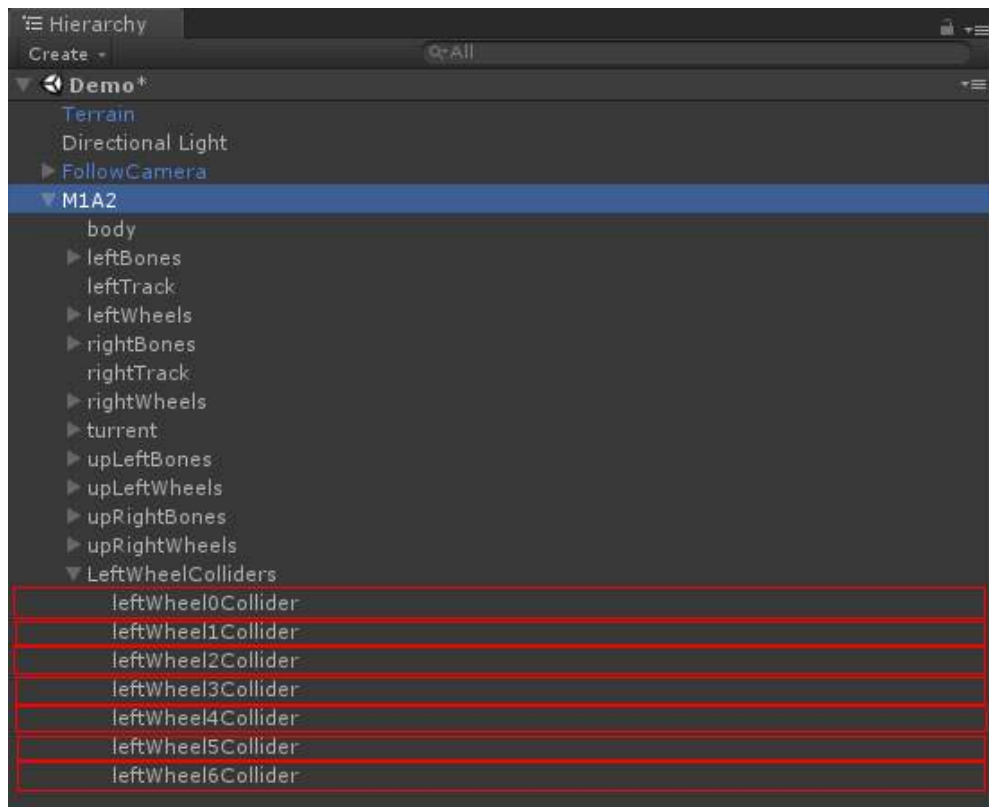
Separately Clicking the green buttons named *Create WheelCollider* which belong to their corresponding row to create 7 WheelColliders, and the names of these 7 WheelCollides are leftWheel0Collider, leftWheel1Collider, leftWheel2Collider, leftWheel3Collider, leftWheel4Collider, leftWheel5Collider, and leftWheel6Collider



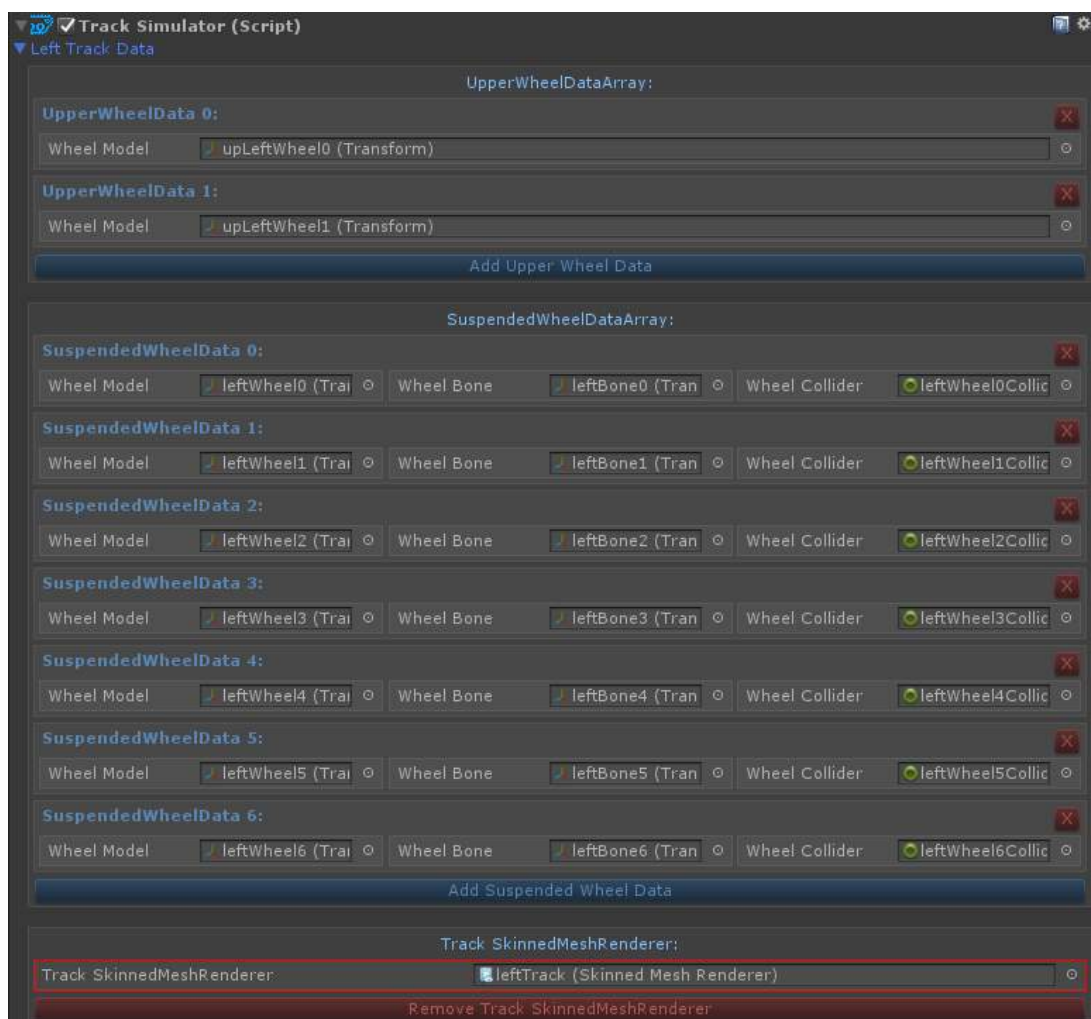
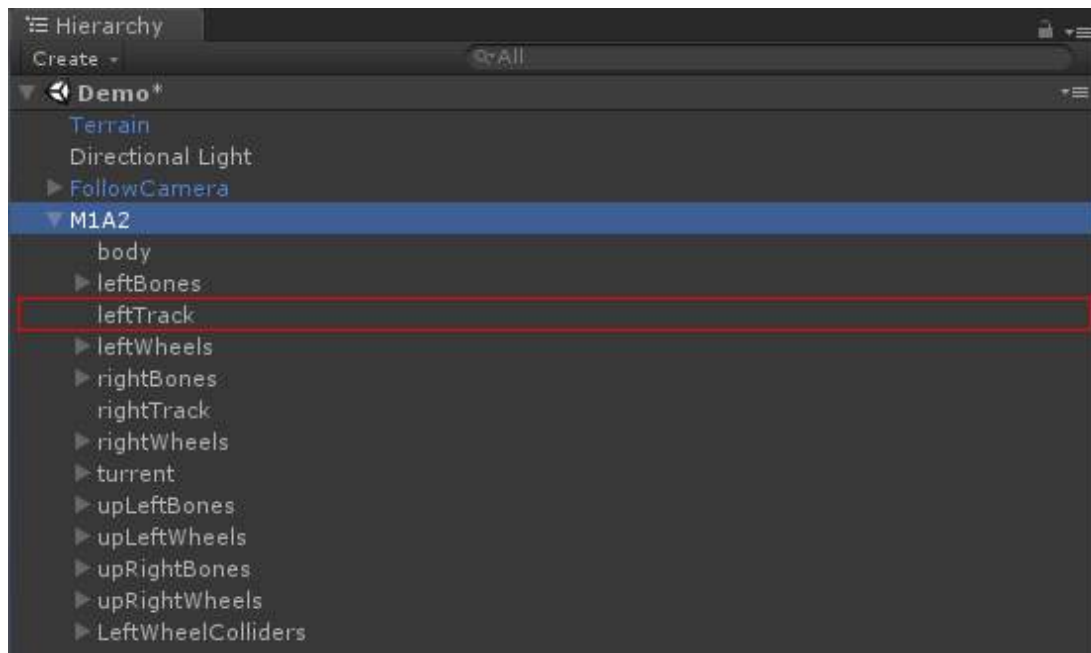
In the view of Inspector, the 7 WheelCollider which have been created display below:



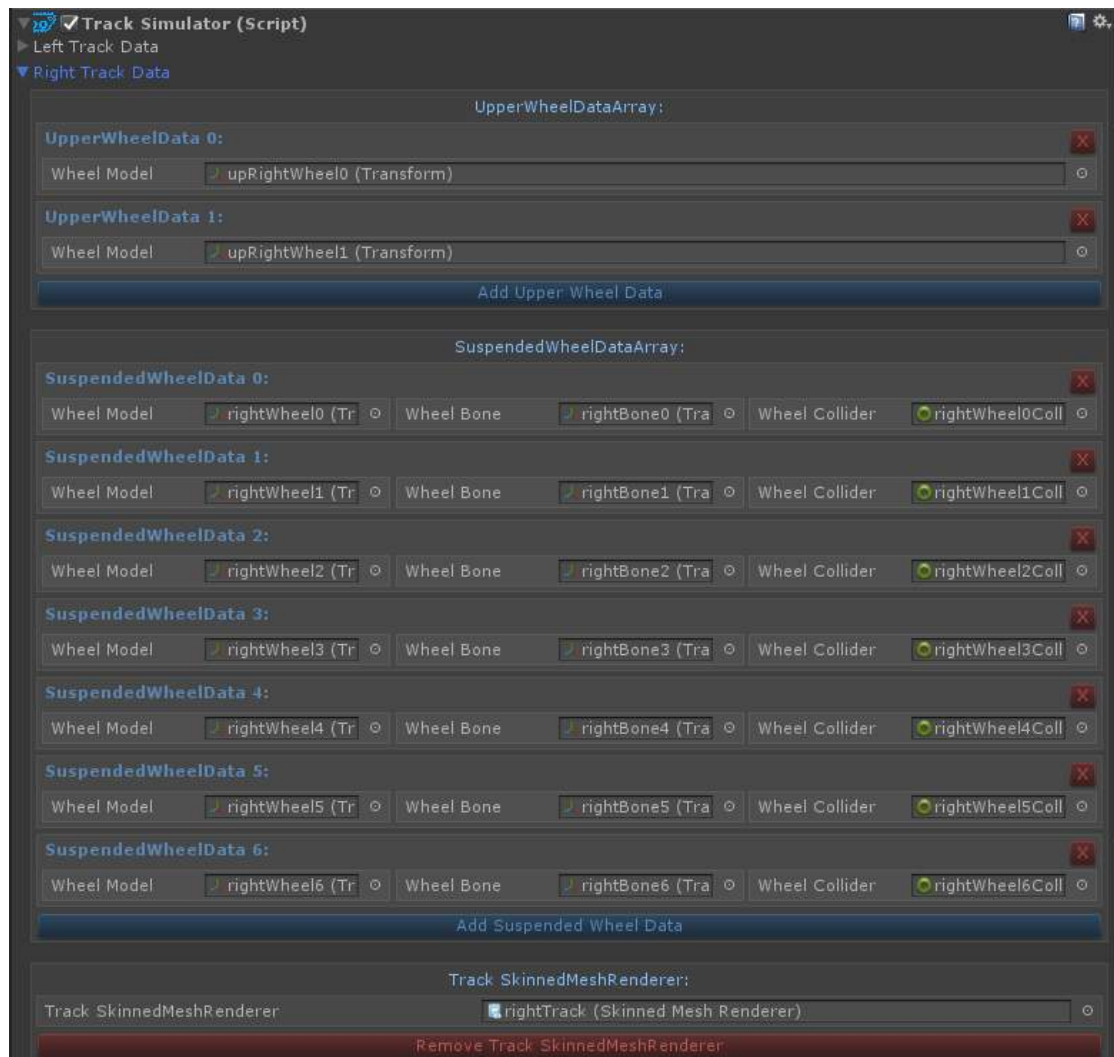
In view of the Hierarchy, the 7 WheelCollider which have been created display below:



In the view of Hierarchy,selected left track of the tank,dragging it into the field named TrackSkinnedMeshRender which belongs to the area named TrackSkinnedMeshRender

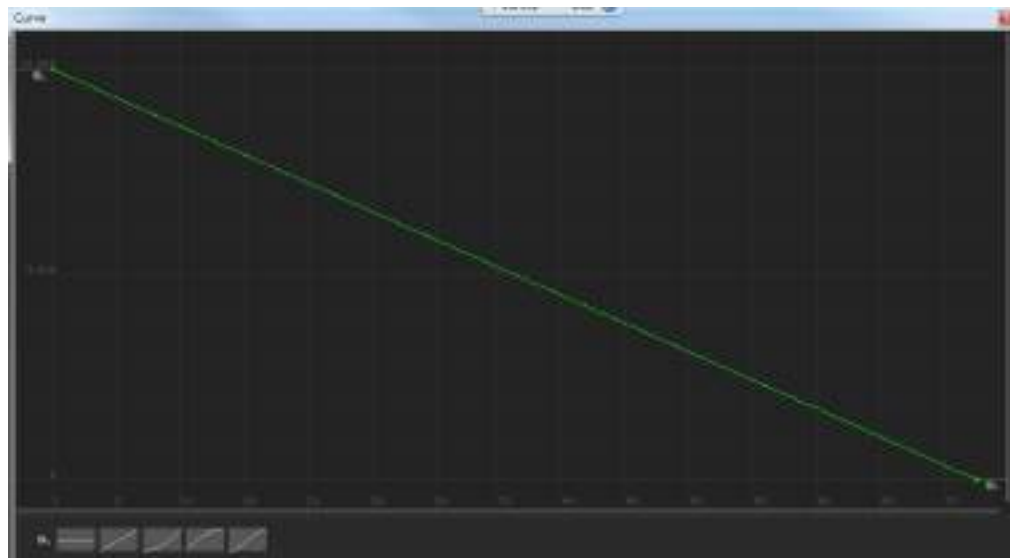
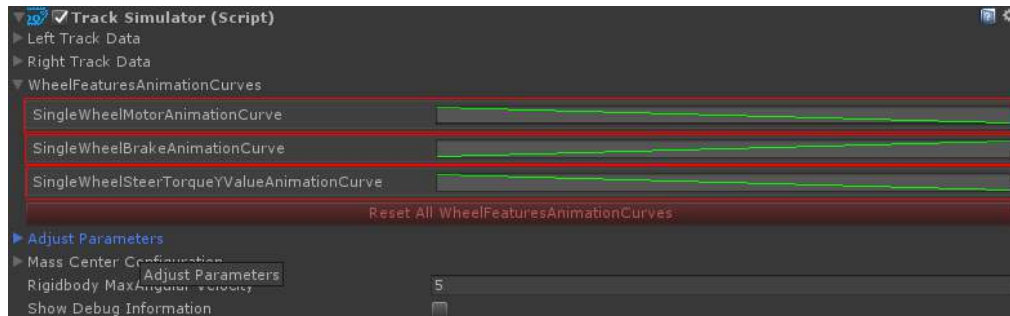


The configuration interface named *Right Track Data* 's setting method is similar to the configuration interface named *Left Track Data*'s setting method.

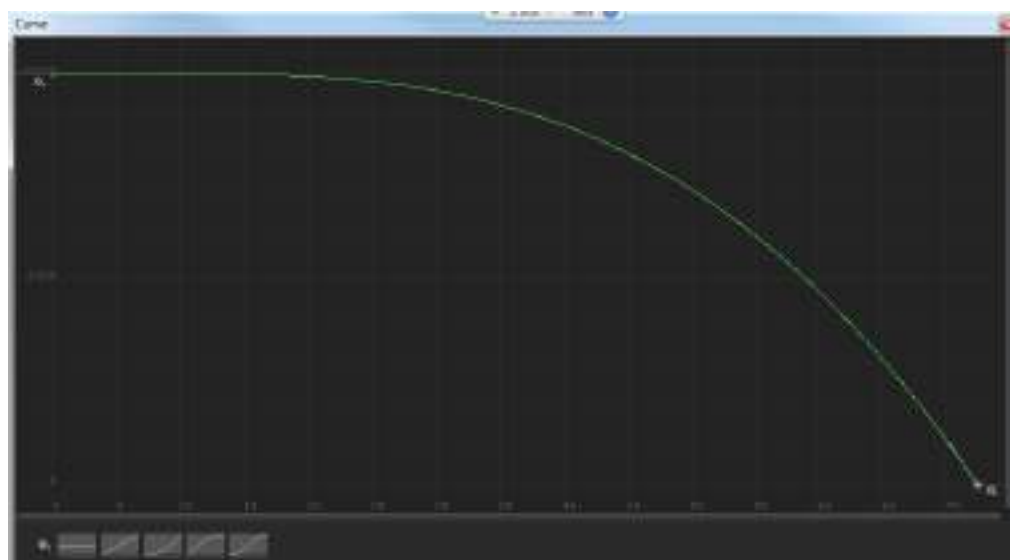


(3) Configuring wheel collider features curve

Double click the animation curve named *SingleWheelMotorAnimationCurve* which located in the area named *WheelFeaturesAnimationCurve*, then the unity will pop up the animation curve editor.

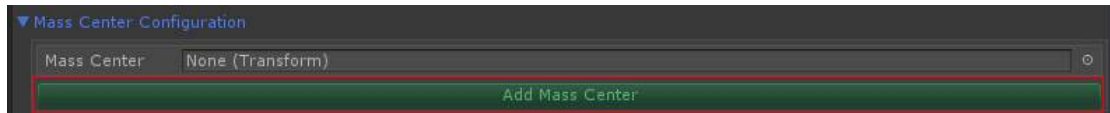


Modifying the shape of the animation curve named *SingWheelMotorAnimationCurve* in the animation curve editor which has just been popped up.

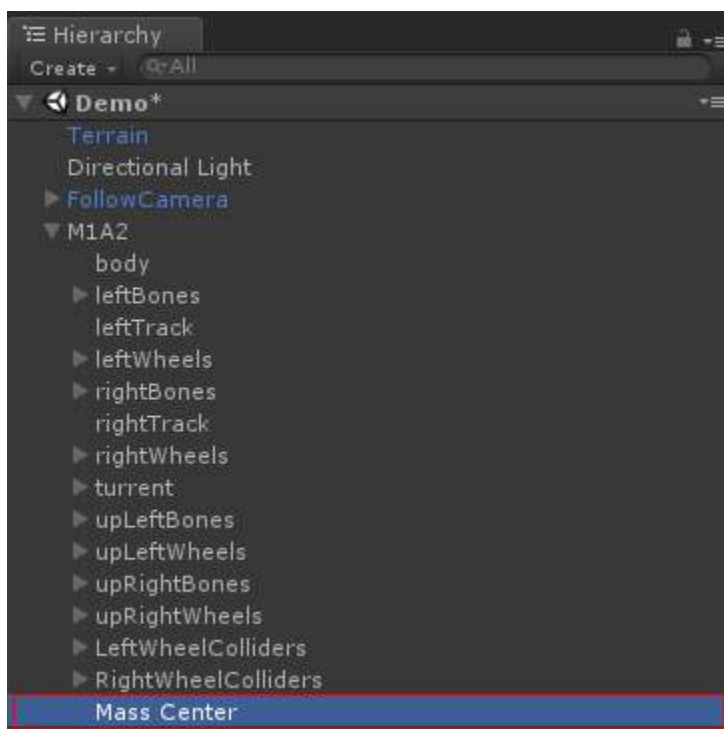


(4) Configuring the mass center of the tank

In the area named *Mass Center Configuration*, Click the green button named *Add Mass Center*

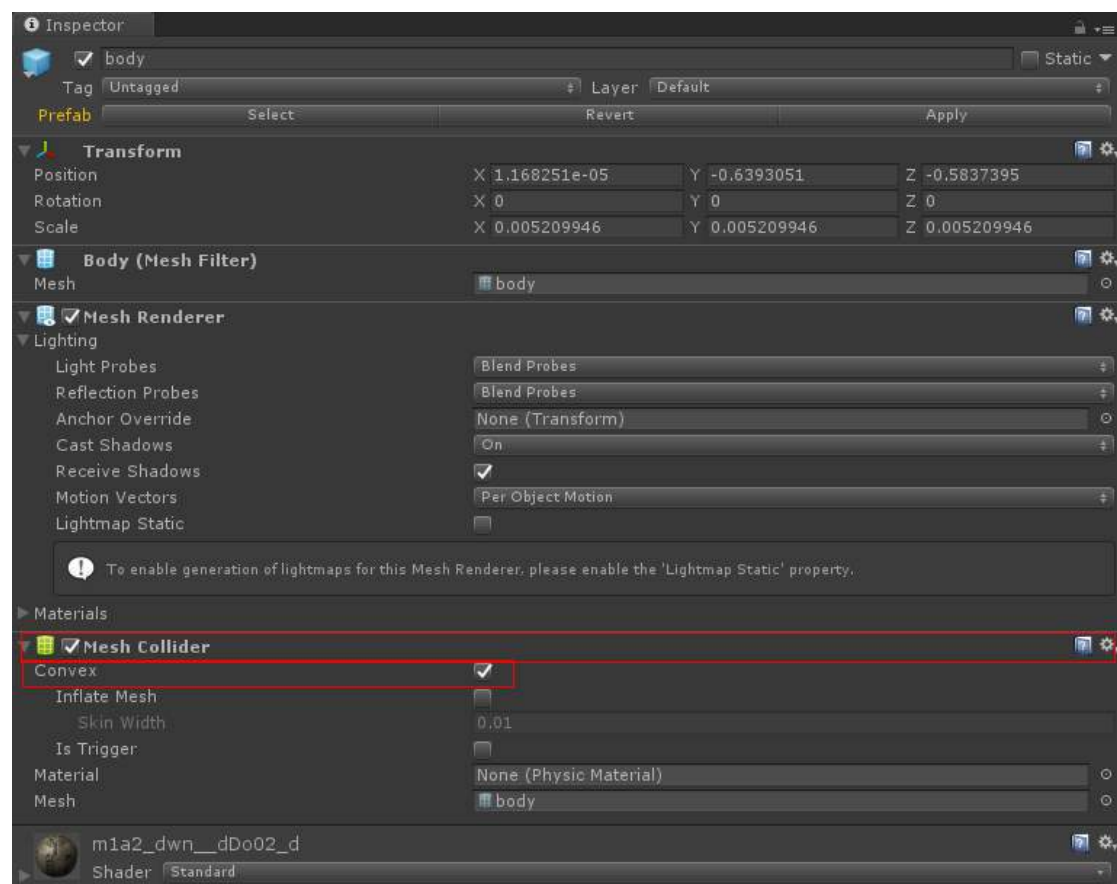
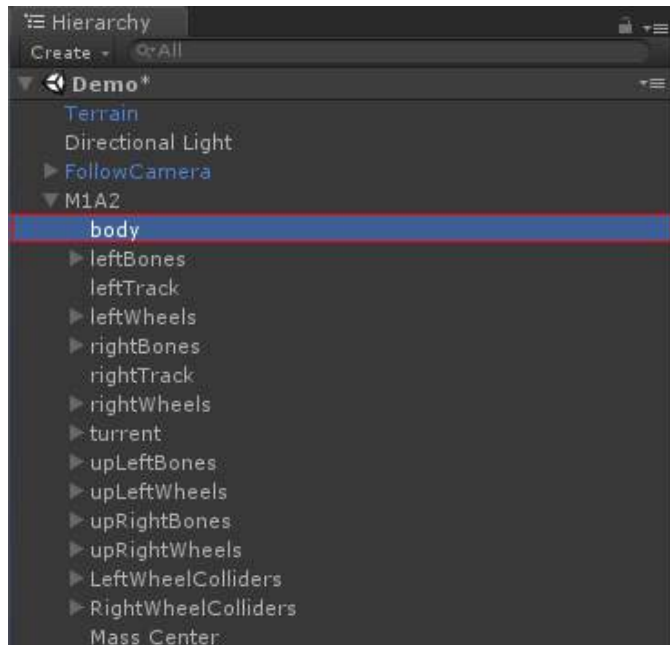


It will automatically create a gameobject named *Mass Center* under the root gameobject of the tank, and initialize its local position to (0.0f,0.0f,0.0f). We set the value of this property named *Offset* to (0.0f,-1.5f,-0.3f)



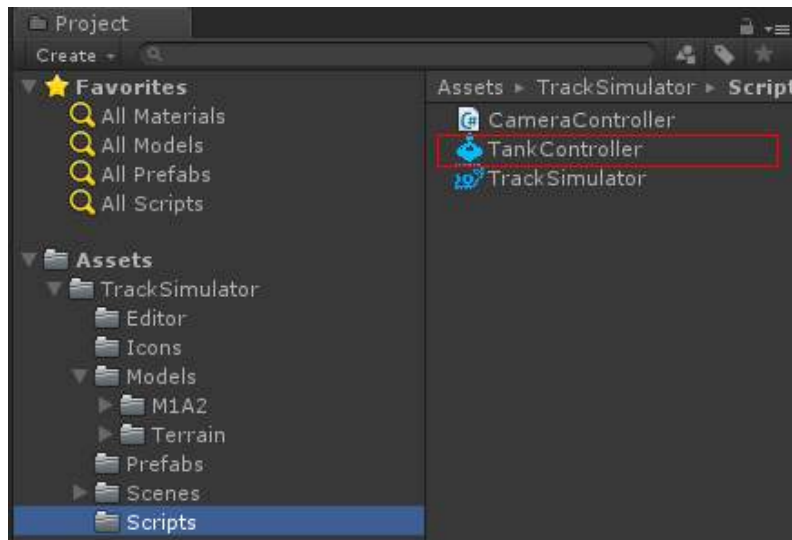
(5) Adding collider to the body of tank

In the view Hierarchy, selected the gameobject named body, add the mesh collider to it, and checked the Convex option of the mesh collider.

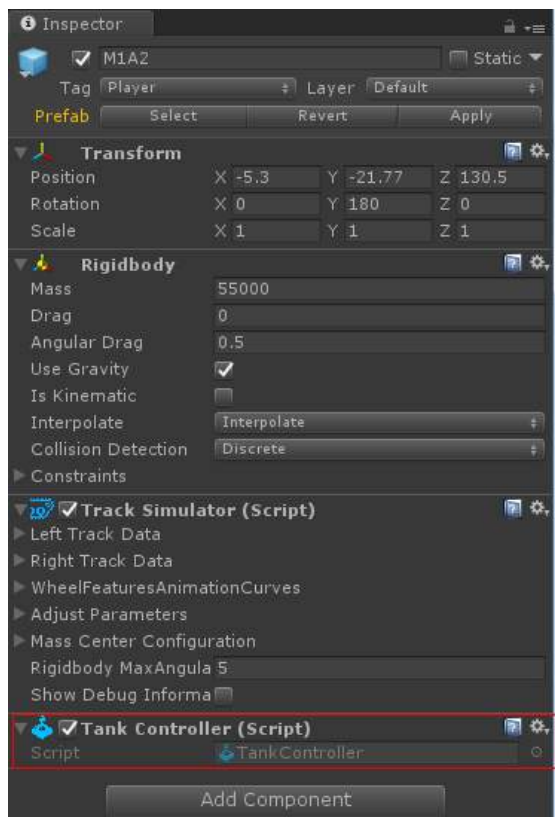


(6) Adding Tank Controller component to tank

In order to use keyboard to drive the tank, we need to add the Tank Controller component to the root gameobject of the tank. The TankController script is located in this folder: Assets/TrackSimulator/Scripts



Selected the script named TankController, we drag it to the root transform of the tank



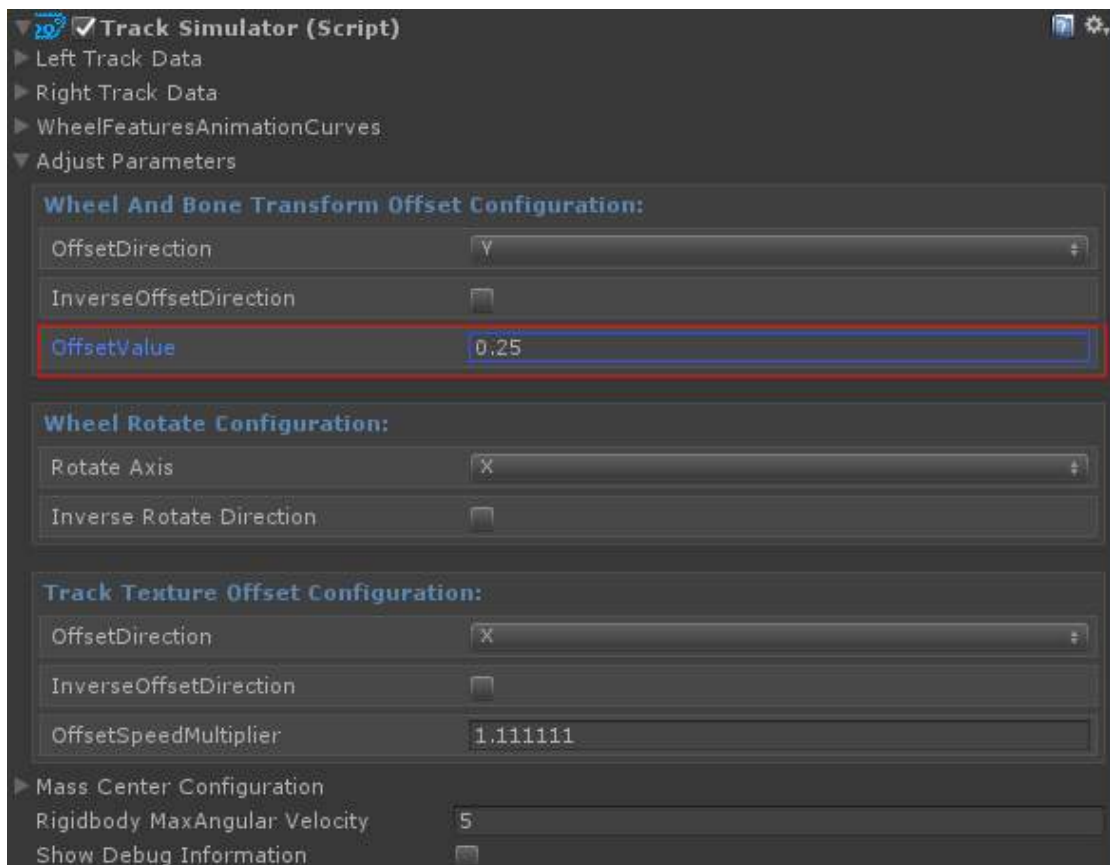
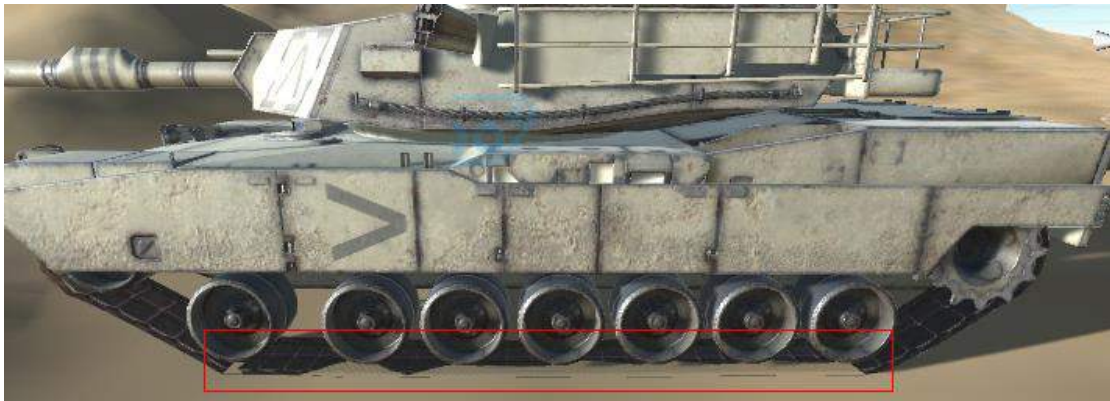
At this point the tank installation process has been completed.

5. Adjusting parameters after installation of a new tank

(1). Adjusting wheel models and wheel bones' offset value in vertical direction relative to the root gameobject of tank

When tank's tracks have been set up, running the game, we found the track crossed the ground.

Here we adjust the field named OffsetValue to 0.25, this field named OffsetValue belongs to the area named *Wheel And Bone Transform Offset Configuration* which belongs to the Configuration Interface named *Adjust parameters*.

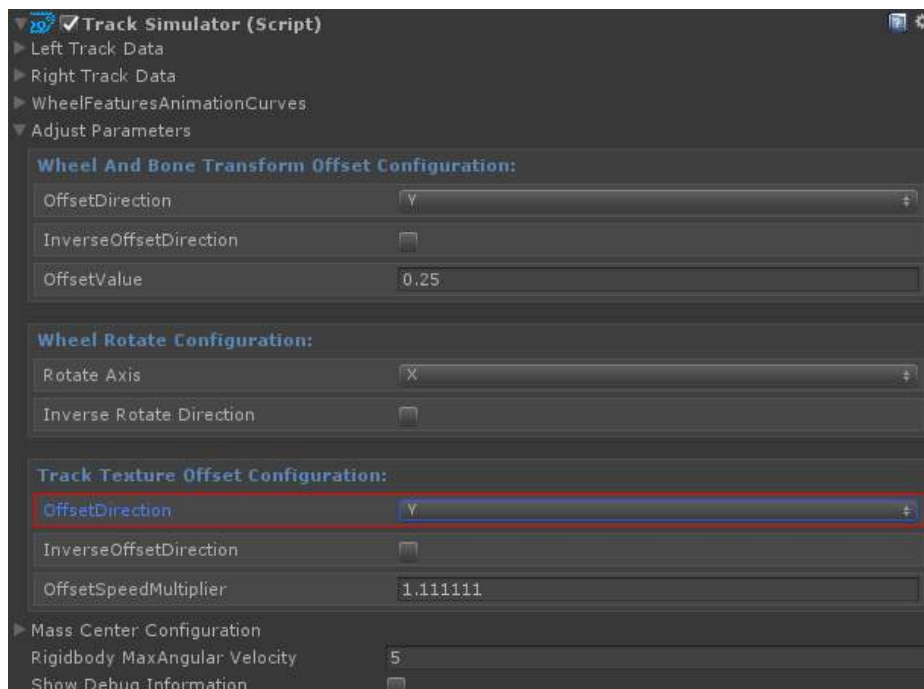


(2) Changing the offset direction of track's texture

When game is running, we found the offset direction of track's texture is wrong

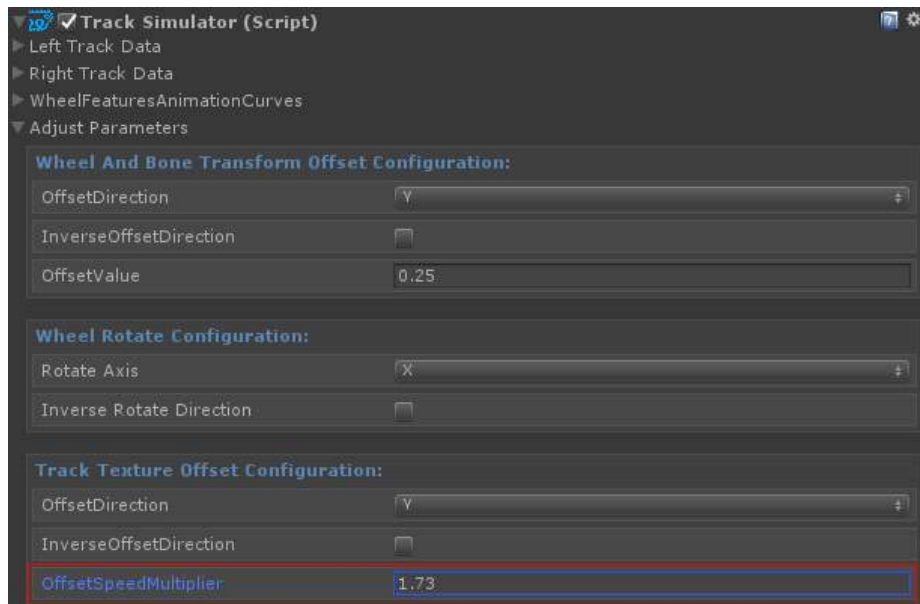


Here, we change the field named `offsetDirection` to Y axis, this field named `offsetDirection` belongs to the area named `Track Texture Offset Configuration` which belongs to the configuration interface named `Adjust parameters`.



(3). Adjusting the offset speed of track's texture

When we running the game, we also find the offset speed of track's texture is not in harmony with the rotation speed of the wheels. Here, we adjusting the field named `offsetSpeedMultipiler` to 1.73, this field named `offsetSpeedMultipiler` belongs to the area named Track Texture Offset Configuration which belongs to the configuration interface named *Adjust parameters*.



Running the game, we can see the tank track's performance is correct now:



6.The video tutorial on youtube

<https://youtu.be/u3Pla3QYQyc>

7.Contact information

If you have technical difficulties, please contact me by email. My email address is 18311310080@163.com