

# Creating and Rendering OLD/Used Cricket Ball using Renderman

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## Abstract

The aim of this assignment was to model a simple primitive using python API for Renderman and to shade it observing the various patterns, wear and tear on the chosen object along with other camera artifacts. An Used or Old cricket ball (cricket balls for higher levels of play are made of hard leather mixed material) was chosen as the object, as it is simple to model being spherical and also has many other features on it such as displacement along the seam, large wear and tear caused due to coming into contact with hard surfaces like a cricket ground for a longer part of time than any other sport.

## 1. Introduction

Due to the nature of the sport, a red leather ball loses its shine after almost half a day of play revealing its rougher inside and shows various shades of the red leather used to manufacture it. The images below are of real match-used university cricket balls. As it can be seen, different shades of the same surface is on either side of the seam. It can be seen from Figure 1 that the ball has obvious wear and tear all across the surface. It was also evident that older balls had negligible amount of reflection since it had lost its shine and also there was a rim light effect on the seam of the ball at times in certain angles on certain balls as it can be seen from the ball in Figure 1.1 and 1.2. Even though it is hard to see, there are minute details of small pore like dots all along the surface of the ball which is the reason for the ball being rough.



**Figure 1.** Used Cricket Balls photographed after 25 and 35 overs of usage respectively.



**Figure 1.1** Slight rim lighting visible on the seam

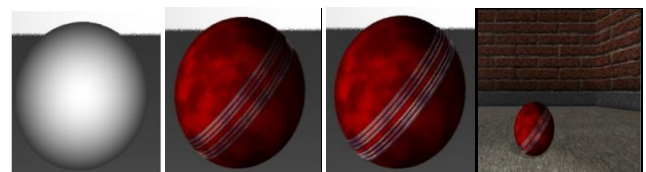


**Figure 1.2** Slight rim lighting visible on the seam

## 2. Modeling the Cricket Ball

Modeling a ball is simpler as a spherical representation is available in Renderman by default. Hence, it was used with the python API to create the basic model with a displacement being applied on the central axis and around it for creating the seam of the ball as explained in Section 4.

Below are the images of the various stages of development starting from the basic spherical model, wear and tear on the surface with white central axis, displacement along the seam (central axis) and final image being rendered in a scene with an environment map in order from left to right.



**Figure 2.** Stages of Development (stage 1: model, stage 2: surface shaded, stage 3: bump along the seam, stage 4: placed in a scene)

### 3. BRDF model

An old leather ball usually has low specular highlights along its surface and faint rim light towards the edges of the seam as seen in the earlier Figure 1.1. So a basic shading model was chosen and then tweaked for the specific requirement. This is most similar to the ADS shading model of the GLSL shading language where constant shader is combined with the diffuse shader and then with the specular. Additionally, a very minute rim light effect has been added on the seam edge of the ball as shown in Figure 3.



**Figure 3.** Close up of seam showing its bumpiness and faint rim lighting along its path

The entire BRDF model is explained below:

$$C_i = O_i * C_s * \text{surfcolor} * \text{base} * (\text{diffusecolor} + \text{ambientcolor} + \text{speccolor}) + \text{rimFakeLight};$$

Where,

**surfcolor**, depends on how old the ball is in terms of the number of overs it has been used in a cricket match at a particular point of time ( say 35 overs ball, 25 overs ball and so on). This age parameter is given to the external user to be manipulated through input rib file.

**base**, is a splined mixture of various colors added with a turbulence to replicate the varying random reddish texture on the ball

**diffusecolor**, is the conventional diffuse model which is  $K_d * \text{diffuse}(N_f)$ .

**ambientcolor**, is the conventional ambient model which is  $K_a * \text{ambient}()$ .

**speccolor**, though not a major contributor in terms of the lighting model, it gives a subtle influx of spec highlight based on the roughness input into the surface shader. Since an old ball displays extremely insignificant specular effect, it has been reduced in the output image to a minimum and is the result of  $(K_s * \text{specular}(N_f, V, S_{roughness}))$ .

**rimFakeLight**, is added on to the entire equation to have a faint light at the top and bottom edge of the seam and is derived using

$$\text{rimFakeLight} = \text{smoothstep}(1 - \text{rimFakeWidth}, 1.0, (1 - V \cdot N_f)) * \text{rimFakeStrength} * \text{rimFakeColor}$$

Apart from the above, a basic shader based on Jon Macey's slides has been used for background and base texturing as below:

$$C_i = O_i * (C_t * (K_a * \text{ambient}() + K_d * \text{diffuse}(N_f)) + \text{specularcolor} * K_s * \text{specular}(N_f, V, \text{roughness}))$$

### 4. Displacement

As mentioned earlier, cricket ball has a seam area which is a set of stitches to hold the ball together as shown in Figure 3. It typically has 3 stitches on either side of the central bump joining the two halves of the ball. This was achieved by displacing the points and recalculating the normal at those central points as below:

$$\begin{aligned} \text{Vector diff} &= \text{normalize}(N) - \text{normalize}(N_g) \\ P &= P + (\text{normalize}(N) * \text{inputKm}) \\ N &= \text{normalize}(\text{calculatenormal}(P)) + \text{diff} \end{aligned}$$

Where, **inputKm** determines the scale of the hump

### 5. Natural Wear and Tear

Fine wrinkle/pore like features as in Figure 3 which are typical of a leather ball surface were added on based on the equation below using noise technique based on input frequency :

$$\text{float wear} = \text{abs}(\text{noise}((s+0.3) * \text{frequency} * 3, (t-0.3) * \text{frequency} * 3) - 0.8);$$

This wear was introduced into the points to create the wrinkles, only based on a threshold condition as these are not required on the seam area. Hence, these were added only in the non-seam surface area. These fine grained wrinkles can further be spread using the frequency parameter. This subtle but effective variation helped significantly in improving the look of the final render to resemble a real ball rather than a flat surface.

### 6. Environment map

Generally, used balls either end up in a warehouse or a backyard. The environment textures for the warehouse wall and the ground were borrowed from the internet and converted to .tx files using the command to make it usable inside Renderman.

txmake <input file.jpg> <output.tx file>

As explained earlier, the older balls are low on their reflection and hence only extremely minute visible features could be spotted with the environment map being included in the lighting model of the surface.



**Figure 4.** After including environment map into the lighting model using environment (<texture>) function. Color attribute Cr was assigned this environment map using world transform

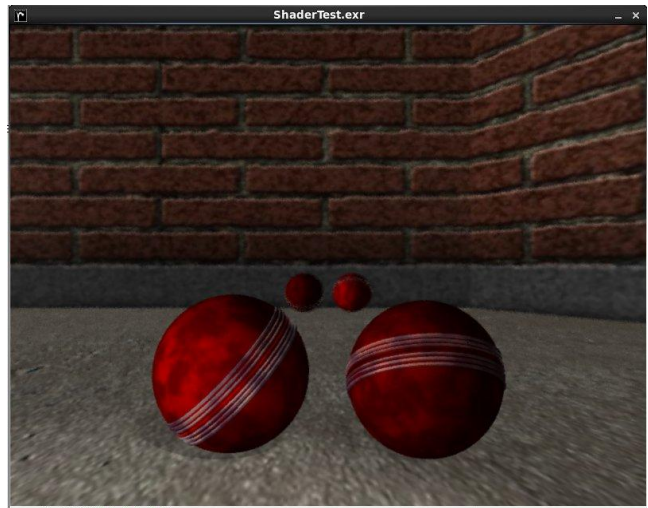
## 7. Environment map

This basic scene set in a warehouse has an unattractive Grey ground texture chosen to deflect the attention off the ground towards the balls. For scene1, only one ball which is 25 overs old has been placed using rule of thirds with an appropriate rotation showcasing the seam of the ball and a more reddish surface. For the scene2 again, the main balls placed in front of the scene are placed approximately around the 2/3rd areas of the image. The ball on the right side front in scene2 has been appropriately rotated to show how realistic the seam looks in different angles and is 35 overs old showing a darker shade of leather as the ball gets softer when it is used for a longer time. Also, two more balls are placed into the scene deep against the walls to depict the depth of field. Automatic shadows using shadow spots through ray tracing has been added into the scene to produce realistic output from a combination of distant light (cast on walls) and ambient light.

*Note: Please refer to images submitted separately for the final render images. Images included here were resized to be accommodated into the report for representation and all the details on the surface of the ball may not be completely visible here.*



**Figure 5.** Scene 1



**Figure 6.** Scene 2  
(Differences in the ball colors due to its age is best visible on a bigger monitor with RGB color set to 1, 1, 1)

## 8. Camera Artifacts

Since the balls are set against the backdrop of a warehouse, they are meant to be static. Hence, no motion blur was added to the balls. A depth of field has been added to the camera as below:

```
DepthOfField(64,1,2)
```

An fstop of 64 and a focal distance of 2 was chosen keeping in mind the scene was intended to have the balls in front being in sharp focus and a minute blur to the balls at the back.

## 9. Conclusion

Fine observations of used cricket balls were required at various stages of their life in terms of the number of overs used. Being in the university cricket team helped as I could get whatever type of used leather balls I needed to observe at various stages of their use. Once the BRDF was decided, all the other parameters such as displacement, wear/tear and the noise factors worked well on each stage of the development. Overall, it was very good to observe and know that every minute detail on the cricket ball contributes in a significant way to the appearance of the surface.

## References

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