A discussion of light mods

Recently LRMv4 was released - following up on earlier versions and including improvements found in other light mods. I had used the Uniform Light Mod a bit and liked the concept so when LRMv4 came out I thought I'd try it out. To be frank I was at first underwhelmed but it took me quite a while to figure out why – this discussion follows from my personal investigation.

I actually now use a modified LRMv4 – the basis of which I will explain later. It took a bit of luck and a lot of perseverance to get the result I have – If it to be more widely implemented it will be a lot of work (and it has side effects) – however if enough people like the result it may one day be done.

Contents

A discussion of light mods 1
How Light Mods are rendered by SC4. 2
Maxis Night is too blue and bright – Dark Nite is too black and dark 2
Light cones should be conical 4
SC4 diagonals present a spacing problem 4
Starting from a Dark Base doesn't help 4
One Pass Color Cones 5
Two Pass Light Color Cones 5
Another alternative Nite 6
Seeing the Lights not just their Cast 7
Putting it all together 7

How Light Mods are rendered by SC4.

Light mods like LRM are rendered by SC4 by merging the "light" onto the background after everything is projected and rendered. This means light sources need to be blended in real projection and offset from the roads so as to cast light correctly onto them.

The Light textures themselves are blended in a single pass using the following formula

```
ResultantRGB = Max( OriginalRGB * (1 + LightRGB/255), 255)
```

Where `OriginalRGB` is the colour before adding the light and `LightRGB` is obvious. If the result is more than 255 in any channel, that channel becomes at most 255.

Example.

A Road is dark and say (60,60,60) in colour. If we have amber light (255, 200, 40) then after rendering the Road color would be (120,107,69)

Min( *(1 +  /255),255) = 

R = Min(60*(1 + 255/255),255) = 120, G = Min(60*(1 + 200/255),255) = 107, B = Min(60*(1 + 40/255),255) = 69

Sidewalk pavement might be say (200,200,200) in color after blending the light it would be

Min(* (1 +  /255),255) =

R = Min(200*(1 + 255/255),255) = 255, G = Min(200*(1 + 200/255),255) = 255, B = Min(200*(1 + 40/255),255) = 231

Note how the Red and Green channels have saturated and the result is a pale yellow. What this means is that there is a practical limit to how bright the light can be, but this depends entirely on the Original colours. This is what happens when multiple lights are too close together – the whole washes out in a bright light.

[aside: We can also invert the formula to find MaxLightRGB = 255*(255/OriginalRGB – 1). Original not 0]

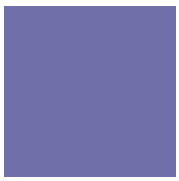
Maxis Night is too blue and bright – Dark Nite is too black and dark

The items in a SC4 scene are rendered in various ways depending on their nature but all up a daytime rendering leaves a White (255,255,255) item rendered as (226,224,225)

Night time rendering is a daylight rendering * a Night Colour

When multiplied by the night color the daytime white now becomes

Light Mods

MAXIS NIGHT 113 111 170 

DarkNITE 43 44 63 

These represent extremes to the presentation of streetlights.

For these and a one pass blend then amber light will render as

MAXIS NITE

Road Min( *(1+  /255),255)= 

Footpath

Min( *(1+  /255),255)= 

Dark Nite

Road Min( *(1+  /255),255)= 

Footpath

Min( *(1+  /255),255)= 

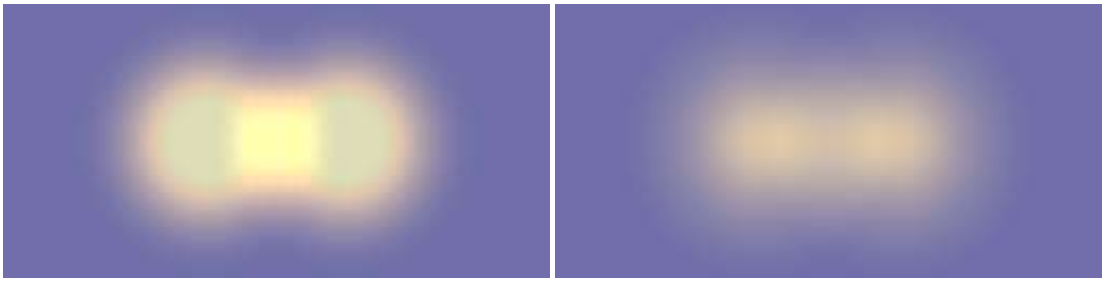
In Maxis Nite it is quite easy to saturate the Blue Channel, but it cannot render a darker white than (170,170,170) and it is very difficult to remove the blue cast on lights. Lights placed too close together will oversaturate very easily – in any case the night doesn't look like night.

In Darknite it cannot become saturated at any value of light, but it cannot render any colour brighter than (88,88,126). It is just Too dark. So the light mods are underwhelming in DarkNite.

Light cones should be conical

So there are limitations in how bright the colour cones used to render the light can be. It is also predetermined what colour the cones must be to get a given colour effect (on white). Physics also tells us that light expands according to an inverse square law so the cones need to be that - cones. Normally when two lights are projected with cones that overlap the sum of the two in the space between them should be less than either on its own. Lights are designed and spaced so that the light levels are as constant as possible.

The colour cones in the current LRMv4 mod are not conical, they are capped spherical. This has the following side effect that shows up best on the freeway lighting – the gaps are brighter than at the lights. Left as in LRMv4, right uses conical light intensity.



The correct intensity is given by

```
Min( MaxLightValue / (r*r + h*h),255)
```

where h is height, r is a radial distance from the pole. I wrote a program to compute it.

SC4 diagonals present a spacing problem

Because T21 mapping is based on squares – orthogonal axes, light pole spacing on diagonal roads is generally larger than on orthogonal roads. This means we must either use 2x the intensity (think about it) or tighten up the spacing and use a lower intensity cone for diagonals. The former is not really on because of above – that means the latter is the best form of attack.

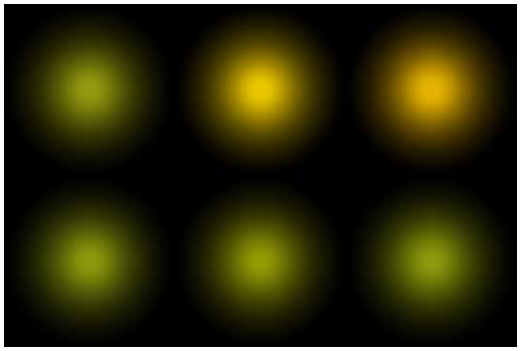
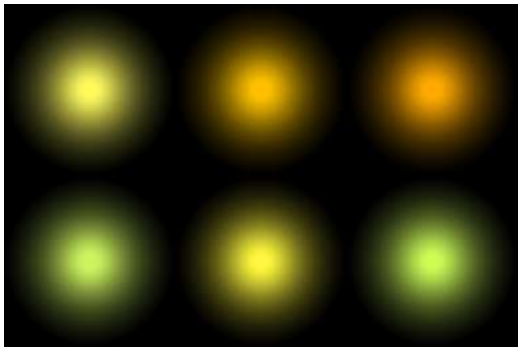
Starting from a Dark Base doesn't help

Black Roads, RHW and NWM clearly make showing lights on them very difficult. They are too dark. Streets and Freeways and to some extent Avenues look OK. Maxis nite works better than DarkNIte in this case.

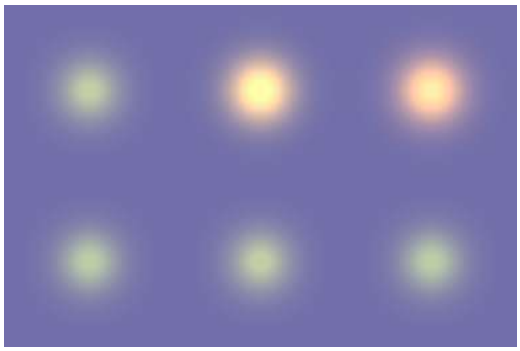
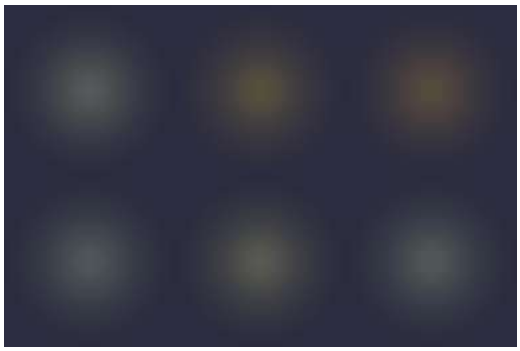
One Pass Light Colour Cones

So now we can redefine the colour values needed for a one pass lighting system. Here are the corresponding Light cones for LRMv4 that can work as drop in values for the 6 colour cones.

They are White Light, Hi Pressure Na, Lo Pressure Na, Cyan, Yellow, Mercury,

Maxis Nite  DarkNite 

Taking a white value and applying these light colors looks like this

MaxisNite  DarkNite 

Maxis night is slightly overexposed and DarkNite will still look Dark. Color definition isn't great.

Two Pass Light Colour Cones

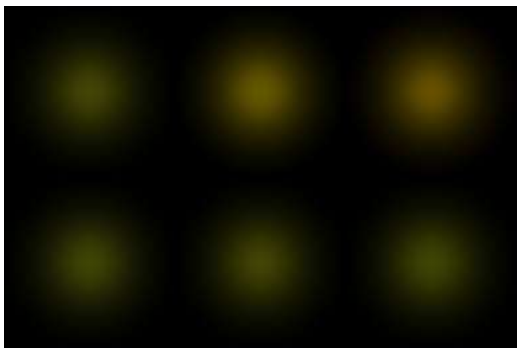
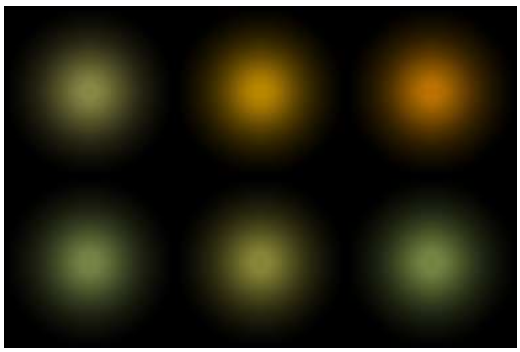
I have somewhat fortunately discovered that we are not constrained to one pass for blending.

Since the blending operation is discretely one pass and explicitly defined in the exemplars for the lights, we can in fact blend the same texture more than once and so it becomes possible to get very fine control over the colours produced.

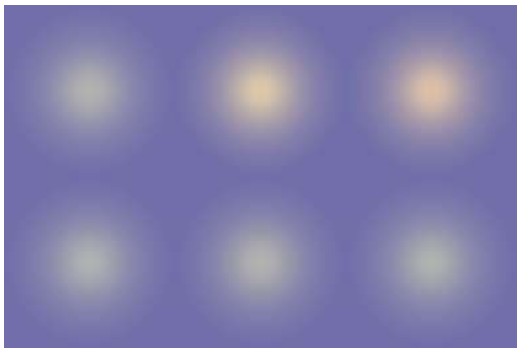
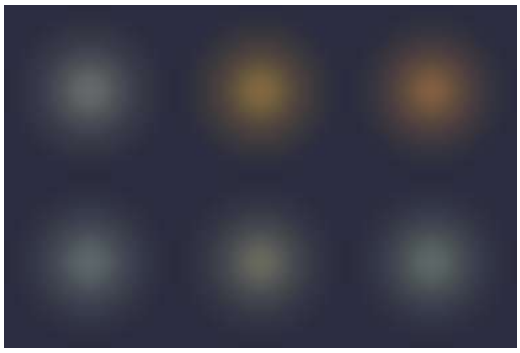
This is equivalent to `FinalRGB = Min( OriginalRGB(1 + LightRGB/255)^2,255)`

In the case of DarkNite this means we can get a lot brighter – although it probably needs 3 passes to be completely convincing.

Light Mods

MaxisNite  DarkNIte 

And results

MaxisNite  DarkNite 

Because we are blending twice we gain more control over the colour and intensity of the lights

However rendering costs rise by one pass for each light and all of the mod would need to be updated to o this. There needs to be a better reason for doing this.

Another alternative Nite

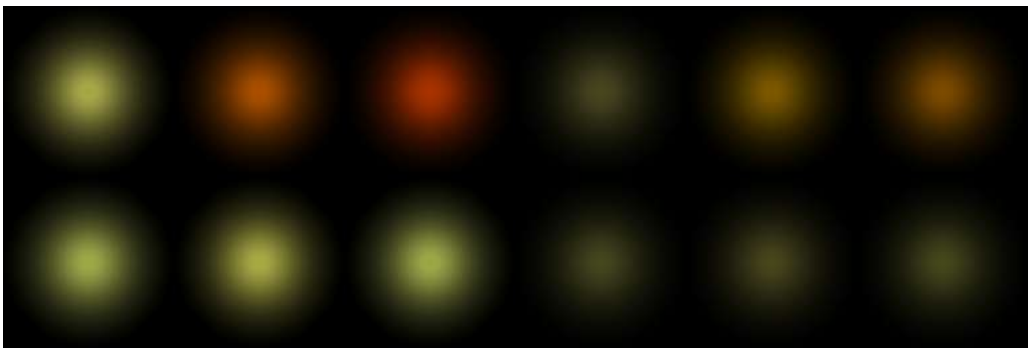
If we pick the two pass solution there is a way to improve colour definition further – i.e. By brightening the nite colour. After a fair bit of trial and error I've settled on a night value of (77,77,98) as my resultant night value for white - about halfway from Maxis to Dark Nite.

It looks like this:  . It's still quite dark, and it has a little more blue than DarkNite.

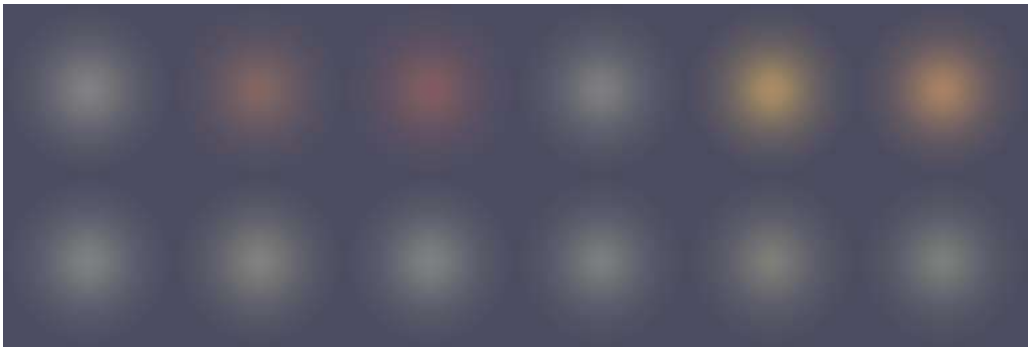
Its real advantage is that a two-pass color blend of white can saturate to white. (77*4,77*4,98*4), it can also represent a minimum white of (98,98,98).

Colour cones are

Light Mods



Leading to



Seeing the Lights not just their Cast

The LRM mod does not show the globes of the lights making the light on the roads. This is entirely reasonable as the angle from which we view the streets in SC4 is high enough that the globes would be obscured. Maxis did however put them in – and now they are missing the streets look somehow wrong according to our real-life experience.

How then do we go about rendering them. The trick is to render a small intense ball of light onto the spot where the light would come from the globe – making it look like bloom. This is quite hard to control and means adding yet more render passes to the lights. I have found that it is possible to render onto the casing of the light to give the impression required.

Putting it all together

My use of the LRM mod is as follows:

- I use Sodium Lights for NWM, Avenues and Maxis Freeways
- I use Mercury lights for Roads
- I use yellow incandescent for streets
- The lots use whatever they were made with.

- I modified the exemplars I needed to be two pass and render the globes
- I modified the T21s to be double density on freeways and diagonals
- I use a modified Night Mod as described above.
- I fixed some lots – mostly car sales yards and some parks which were clearly over-lit.

Here are some examples (untouched except for a resize)

Light Mods