GROUP 7
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ASSIGNMENT 1 – REPORT

On this assignment it was implemented the Turner Whitted's ray-tracing algorithm. This algorithm combines hidden surface removal, shading due to direct illumination, shading due to indirect illumination and hard shadows.

Ray casting implementation

1. Finds the primary array by casting a ray from the eye to the pixel sample in viewport coordinates.
2. The ray tracing function iterates through all object in the scene in order to find the closest object (by intercepting the objects and finding the object with the least distance with the function intercepts).
3. It iterates through every light on the scene and casts a ray from the light source to the calculated hit point.
4. Casts a ray from the hit point and iterates through every object again to check if it intercepts (the point is in shadow).
5. If it's not in shadow (and the angle between the view direction and the reflection direction is less than 90 degrees), it uses the Blinn-Phong model to give color to the point.
6. If the depth of the array reaches its maximum value, it stops.

Reflections

7. Checks if material transmittance of the object is 0 and the reflection constant is higher than 0 (reflective object).
8. If it's a purely reflective object the backward tracing is calculated from the hit point and the reflective colour becomes the recursive colour calculated multiplied by the object's specular constant.
9. If the transmittance is not 0, the object is categorized as transparent.

Refractions

10. Checks the medium of ray with the index of refraction. In case it's 1.0, we're on air otherwise the ray is inside the object and the hit normal is inverted.
11. Using Snell law, the refraction ray direction is calculated. For optimization purposes, not all calculations are made in this step in case it's a situation of being over the critical angle (since it would be just reflection).
12. Using the Fresnel equation, the coefficients of refraction and reflection are calculated.
13. The contribution given by both the refraction and reflection is calculated recursively by casting ray in every point of refraction and reflection.
14. When maximum depth is reached, the results propagates backwards until it goes back to the primary ray. The final colour received is given to the specific pixel.

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RESULTS

Local color component (Blinn-Phong model illumination)

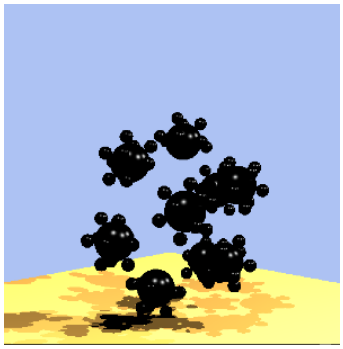

Figura 1. balls_box

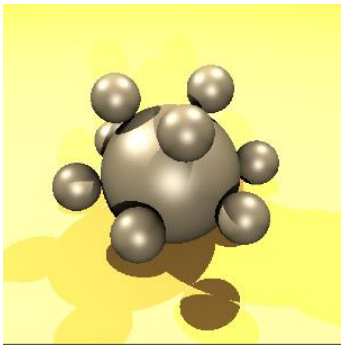

Figura 2. balls_low

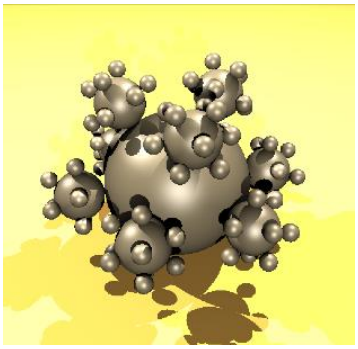

Figura 3. balls_medium

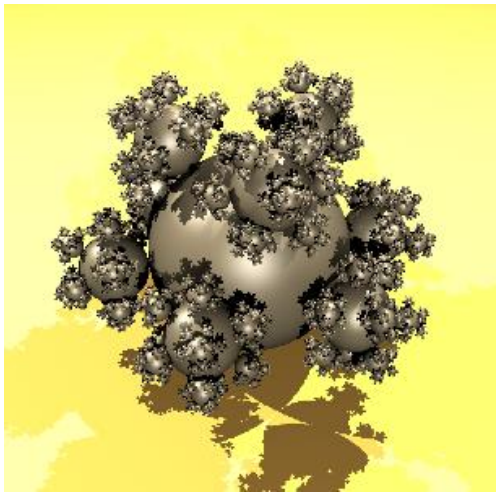

Figura 4. balls_high

Multiple source lights and hard shadows

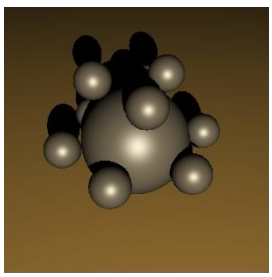

Figura 5. ball_low with light 1

Figura 6. ball_low with light 2

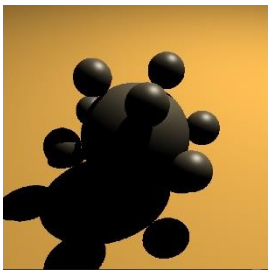

Figura 7. ball_low with light 3

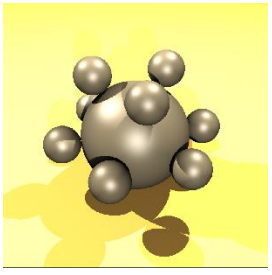

Figura 8. ball_low with all 3 lights

For the next results, we decided to change the colour of the plane for the balls and the background color for the mounts in order for the professor to validate the authenticity of our image result. We also deemed better to lower the light's intensity to get clearer results.

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Global color component by implementing the mirror reflection and refraction

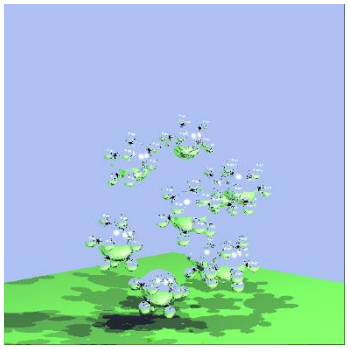

Figura 9. balls_box

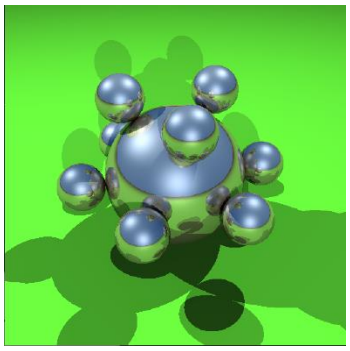

Figura 10. balls_low

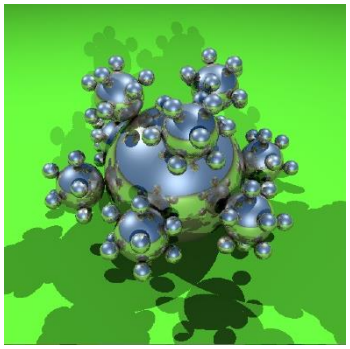

Figura 11. balls_medium

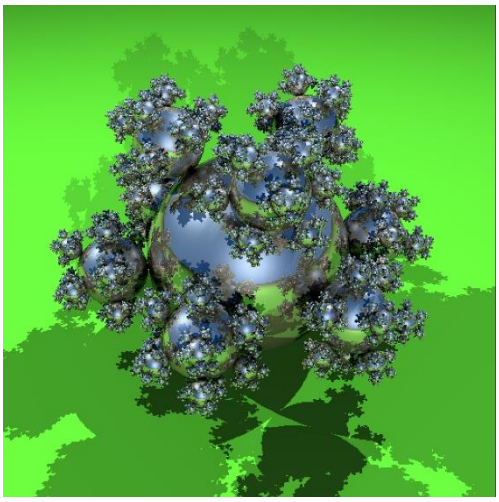

Figura 12. balls_high

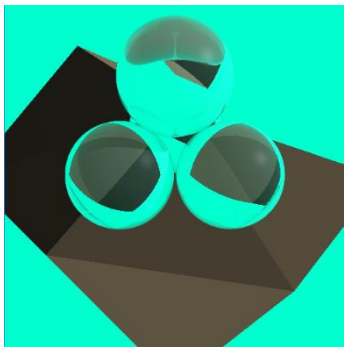

Figura 13. mount_low

Figura 14. mount_high

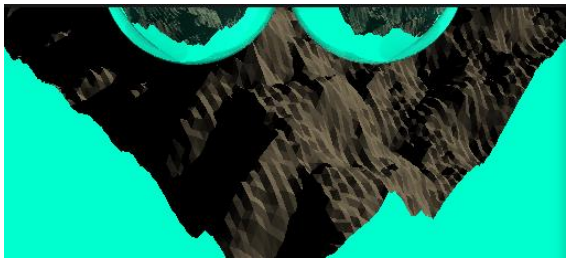

Figura 15. mount_very_high

The mount_very_high.p3f file couldn't finish rendering due to technical limitations.