Games and Simulation

2016/2017

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1. A shiny object, approximated by a triangle mesh is supposed to be rendered in a game illuminated with point light sources. The scene is captured by a moving perspective camera.

   A. Which shading technique would you use and why?

   B. If no normal vectors are defined in the original mesh, what could the game engine do, and how, to be able to evaluate the illumination model at the required locations implied by the answer given in A?

   C. Point out two different problems that arise from the shading technique used and describe why they occur.

2. The individual triangles of a polygonal mesh object are to be rendered as if they weren't flat.

   A. Describe, in detail, a technique that you could use to implement the desired effect. If your effect requires the use of textures to store information other than color, precisely describe what is the information that is stored and how it could be encoded.

   B. Are there any viewing settings that could clearly show the limitations of the technique you described. Justify!

3. The reflection mapping technique known as cube mapping requires the use of 6 different textures.

   A. Describe in detail how these textures can be obtained in a game engine by the engine itself. Be as detailed as possible, providing the exact required settings and values that could not be any different.

   B. Describe in detail how the technique from A. works in practice for a perfect mirror object during rendering. Don't forget to say what the textures are used for (which term in the illumination equation they replace) and how they are accessed.

4. Imagine a game in which the main character, Bob, has to cross a forest while keeping several balloons in his hands. There are two types of gnomes living in this forest, who sometimes show up humming a song. During his trip through the forest, Bob has to overcome some obstacles. He can ask the gnomes to help him with the obstacles. However, when Bob asks for help, in exchange he has to release a balloon. When a balloon is released, it rises a few meters to the right or left of Bob (depending on the hand that released it) and bursts.

   A. Assume that all gnomes sing the same song and that there are two types of gnomes: those with a red hat and those with a green hat. The red hat gnomes have a lower pitch voice. Assume that you have the song waveform, which we call **s**, and that you will use **s** for the green hat gnomes. Explain how you would change this sound in order to get a new sound s' for the red hat gnomes. The spectrum of **s**' should not contain the higher frequencies of **s**. Justify you answer.

   B. Assume that you only have access to a mono bursting balloon sound (one channel sound) but that the sound of the game has two channels and that the players use headphones. Explain how you can change this signal to simulate the sound of the balloon bursting to the left or right of Bob and a few meters high (i.e. the final sound is spatialized and the players wearing headphone should hear the sound from up left or up right). Justify your answer.