### CG\_week6\_lec5HiddenSurfaceRemoval\_1-20241014

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This is that you are in the service model and achievements. Three parts. So the first part, it is separate the whole. In previous lecture, we have the transportation, the 15 and get differently algorithm. Actually, this algorithm, different stages, different state involved in the projection. Basically. It's also known a as a the cost. Russian position is an answer. It's a different. It contains a lot of station modeling transformation. The projection keeping it is simply over and cheating family, developing the rgb images.

So if there is not even certainly, for example, let me feel look at from this cup from your perspective background. The back faces invisible, so we have to intact. Given an object, we project the object is too easy. We have reaching the back face, reaching the front face. So the front face is equation to to the view of the party, and that is invisible. So we have to approach it. So this is an inner separate. So the ladder, this one, the head assembly rooms is also a matter of its ability, determination. For example, in this example, unless this is a projection map, so that is a building apdf this object is hidden by the front object. So it should be invisible when performing the render, when performing the render. This object is it should not be rendered projection. The projection plan is this object should not appear in the final image, in the random image, but we have to know we have to design an algorithm how to do this one, this average that should be invisible.

For example, the patent server removal, the patent server removal itself is a product.

With other hand, is certainly remote. You surrender, you can be wrong. It's a rather image will be wrong for this one. This is a the rendered image without in a certain level. So can you observe which part of the incorrect? Which part of it is? That can you find which part? So you can check it for the lack of a table. So this part, the lab is this part. This is the reason this part should be invisible, because it will be allowed by the table. Right? But without in a certain removal, this part appear in the random image. So it looks the random image. This is the correct. You can compare these three image to find out the difference. So after it is certainly removal is a register image. So this is correct. This is the correct. So this is the wrong. No. Yeah, so this is like the the inner survey always or is definitely combinations. It's in part of the station is in part of it during a random process.

In this lecture, we introduce a few kinds of two categories.

Two categories, actually, the algorithm for determine which option is visible, which argument is visible. It's quite similar. So we have based on if you have a drawing appearance, if you have the drawing appearance, the idea it has simply good for this part, enjoy the meal.

The near part of you cover this part.

So that based on this, observations we can examine the algorithm here is actually we can do 2 kinds of that. Under the first. This is a required objects excels. It's obvious this is becoming given an object that is a particle match, is a part of the national triangle match. So we have to determine which triangle is visible, which country is this. So in the object space before project, the object you miss this, the kind of object of objects established. Here I I that is communism.

So the second category is that is it you make this out of it? Did you make this out of it? So here we can't give it possibility. Tell me what kind of users in at each picture. Suddenly, given an object, we find the object to email, so we have to become the color. They are multiple, let's say, give us three dc right? Give us three dc there are multiple objects located there, located at different desks, located at different desks. When we do our desks, some object will do that. A project, a similar patient, which color do you use? But that's a different part, different object, different colors.

The object is multiple object may project in the same nation oki we project the same picture for the picture which kind of which color. So we really coming up the color image space. So here we can make the that shows an argument. So also a can you have a mechanism? The second one is the buffer that is this atom is a as a bar for it to address the limitation, because an occasion that shock.

So here we quite opinions that cost is like when you performing for the painter really enjoy the general pictures.

So we will enjoy this part. Doesn't mean. So the idea is quite similar and the idea is quite similar.

So for the first category, we call it back this car. They can show it. So the purpose is the purpose is to detect. So let's say I give you a short example. First, let's say this is a triangle. Now. This is a triangle match. For this one. This is regularly, this is regularly is a big show. All the time is out of back with all the back from the fact is kind. So this is a with the fact is kind of. So here you have observers. For this one, for this image. All triangles are ready, even this back, I the backwards, invisible to the viewer. This one is we apply the path is kind of amazon. So that is the triangle should be invisible. It could be a capital triangle. It's a particle face is invisible.

So we will not render that a triangle how to determine given an object, a triangle match, how to know the triangle is visible to the people? Are you visible? Is it from this factors? How can we interview for you? Are required? Is not, I don't know someone, so it is competent. A a it's a triangle object. So that is a bigger composed of the best unit is trying ok so you will look at the color from your perspective. How do you know? So there are a lot of triangles. So how do you know the triangle is I basically using a single and efficient average. The fact is a kind of amazon as the amazon I see is this, for example, that's a if I do to be illustration and you to the industry and this is yourself that this is the circle, the viewer is located here, which we should retain the visible.

You can draw a line, right? Right? This part of the visible can be arrived. So this is part of the invisible. How do you know this part of this? If you have a line, this line should be attended by. This line should be attended by. This is this is a tiny part, right? The time result is that you're sure this is a normal level. So this time we should be. So if the angle is less than 90 °, then so it will be visible. What is the regime? So actually use this idea, you can determine given us three d object, if it's composed of a triangles, we can design a second algorithm, and we can design a second algorithm in time. Yeah. So this is about this congress. Given a part of people are hard to match it, give up hard to match.

So we want to becoming the part of for each time, it's basically the view of facing to the viewer. Invisible. If it's invisible require factors, we quite practice. And so that's it. So the private place, can we use ask you to use the private place? We can compute. This is a two d illustration. This is the viewer. We can compare it better. So the viewpoint, so we use the character b we can select an acting part. So this is the one lines refer to the this is the one straight line response to one final phase in one part of it. So this is the real part of it.

So here we can draw connect. This is 2 point. This is the point of p we can form a vector line. We can form a vector. This is the graph area. This is a graph area, is a normal vector of this part of the phase. Ok here, I also how to compute the I as a normal vector. Given time, we can use that significant. The three vertices, ok you can obtain the two vectors, ok two vectors, and the auto product. The outer product of the two methods is a novel. This is a novel, right? The novel evidence. So this is the calculated the ultimate for that. It also protected two vectors. So this is aaa novel backpacks with red arrows and novel backpacks.

A p this is a part of p this vector, put it on this figure, take it on this figure. We know this part is visible to the view. Yeah. Here I highly wrap. So this part is available to the viewer. You can calculate the product of the inner product. All the dollar product is too better. The normal vector and the vector between real client and as a selective part, ok so here, if you're studying the option, the gender product ok was this one, the product of this factor, and this factor is a negative or positive. That's your positive possible. This vector and this vector I this vector is nothing because the angle between these two vector, it's larger than 90 °, right? It's larger than 90 °. I guess. So it's a map of the value. Here, for this part, is a here based on this figure, we know they are visible part of things.

Ok if we compute the cost in the product of the vectors, and we know it's a negative, you can consider this one. This is part of this. So that's the reason that this part, when you draw that is from this time to so this is the back to the plan over this positive things. Get over this part of the face. So if you contribute the general product, it will be a positive. It will be positive, because the angle is that's and I think it is that.

So based on this observation, so we can define these two criteria. We can define these two computers. If the ginger product is the farmer factor, is a negative based on the sign, it's negative, exactly. The angle is larger than negative. That angle is larger than 90 °. That's what we do know is this otherwise, this is invisible, otherwise is invisible.

Did you find the limitation of the sellers? Did you find the limitation of this effort? This method? No limitation on the failure is, we always have this narrow example, always success. So here you have considered this one. If you use this, that was so you will obtain this is that defined the real time and maybe camera the season products, you will obtain the product is negative based on these two criteria. So it should be classified into the physical, right? And it should be classified to the basic value. But actually, it's a bad case where this is invisible, and the problem better from abuse that sort from rather than from face. So it should be visible. So that means for this region, the average will be okok so the element will be efficient. So why should we take on? That means this algorithm, but this average number is not applicable to all all conditions. If we want to success in this element. There's a condition, right? On the condition.

What's the condition? This ship is a the relationship is a compared, by the way, right? So if we run success, you just have, so the shape must be a come back, ok it must be a complex one. What is the complex? What do you compare? You? Don't buy the past year. You have to take them advanced at nights. What is the complex function? I got a there is a mathematical mathematics situation about what is the complex function, what is computing. Intuitively, you just think about what is the complex, given a ship, right? Given a ship that you just select two parts into part, you just draw the damage is not if this line is completely within the ship, it will be a collapse ship ok yeah, there is a strict mathematics definition. Yeah, for the next ones.

So if you have a job so that any compliance, if the line is outside, ok because the line is outside, so that's it on this ship, right? If you select 2 points at this point, the line is the outside of the tree, is not complex. It's not complex. Yeah, so this is a limitation on the condition of this areas. A it will fail for complete politics. It will feel hong kong given by. Thank you. Yeah, this is absolutely, so it's easy to email it is a medium capacity. The complexity, a is 1 million to the number of part, a number of particles. Given a part of this, if you just process the part of what I want uses atoms, this is a is the fact is, I sorry, the value is kind, as I can see you entirely giving on party phase. So give you a partner match. And given a high profession, you becoming a part of basis, visible, part invisible, the second kind of result.

The second category is, this is an image space algorithm, the image space algorithm, the algorithm and the animation area. I mentioned earlier, is it to determine which color to use, and which color can you use on the left allocation? So that's the visitors really seen. So they are three objects. There are three objects are located at different desks. You take a different task and the view is here, and the view is here. That's the projection plan is there is expected ok so the object will be projected to the aspect to follow the random image, degenerate the random image. Also, we assume that this, what project is three objects to the projection plan for several regions are overlapping region.

So is that a different object, the different projects from a different object, we have projected the signification.

Okay, so that's it. So this is for this bridge. So for this bridge is a the object will overlap the overlapping region ok one project itself, object to the excellent protection plan. So this is a region, a different object. We open that. It's recent. We have to determine which color do you use in the final image in the final image. So the idea is quite simple, ok so the idea is quite simple. We call it that shocking. We call it that shocking on peter diamonds for peter. Exactly. That means that actually that is based on the tactic.

It's a tactical employed by clinton. He said when join the picture, so they will join. This is the part. There is a mere part of the overlap. The distant part will cover them. As a distant part. Based on this, we can design the algorithm. The shock is a first based on the distance and the distance between the object and the projects plan. And the viewer. We perform a shortage, perform a shorting based on the distance between the viewer and the object. Ok the view of the object. We will start the rendering and we will start the radio from the five object.

Reviews comes a little bit from the five subjects. So in this example, in this example, the red object has a large distance, right? Has a large pieces. So the first we will render when you render this red object. Let's see. We assume the project, the rendered object will be project believe, will be projected here. There is a next step. We move to the next one based on the distance. It based on the distance, we move to the next one. This is a yellow object, right? It's a yellow object. So that's in the yellow object will be projected here for the overlapping region. The overlapping region is the color, red color is a picture. But this picture, the color will be replaced with yellow, and the color will be replaced with yellow.

Then we just repeated this process, move to the next one, the purpose object. So for the overlapping reasons, the color will be replaced with them, it will be replacing the tunnel ok so the idea of the question, the idea is present. So what's the limitation? What's the drawback from these characters?

So another thing is, if the option, the this is a transparent object, let's say this, the general object is this is a transparent object. So that means for the overlapping regime, the pictures still should be rendered into recommend for the overlap, how to handle this case, how to handle this case. If it is a transparent object. So exactly for this 11, this is reaches. It should be the pictures can be wrapped readily that. So here this is, we can define which object we can define the past. Okay? We can define the capacity. A is a factor enriched from 0 to 1 to become 00 to 1 gdk the transparency. Ok you begin the transparency. So another, what's the limitation on this error? Or the drawback? Can you suggest one of the patient? So it's a dash, right? That's shocking. So that means the object ok the objects in the informed the same, must be shortened by it, must be shortened with a kind of the distance.

Yeah. So that's if you start from, let's say, we start from the threat of, and so is the yellow object. If you are kind of selling the yellow object, then the proper object will replace this region, then the ground it will depend is a car is wrong, right? The relevant is a relevant result. If it would be wrong, we must start from the finest object. Right? We must start from the finest object. That means we have the kind of which object is the final object, right? After the output, the objects, before the sea must be shot, right? But for some cases, the object can't be shadowed. Right? If the object can't be shadowed, we don't know which one is in front of which one is back, right?

Let's say in this example, the same thing on the left for this case, which one is it from? Which one is that? For seven people for that, also for them, for this one, which one is the front? Which one is back? Some portraits from some portraits of that, right? The object that can't be charged is the object that can't be charged. This happens a little bit here. We have to start from the price object, right? We have to start from the price object, otherwise randomly issue. This is the one of the issues. Yeah. So basically you should the whole process, what part we have to start from the the fighter object, the fighter service ok otherwise rapidly, it would be wrong before you for the objects, if the option that can be shot, if the option that can be shot.

So this element will be just out of the field. This is the one application. Did you find the? But modification is what they said. So you have to perform the short term average, right? You have to from the shop. And we can say that it was that a huge amount of them, if there are a huge number of options in the scene. So the starting process will be in time, you know, you the shorten out of the independence. If there are a huge number of armchairs in the city, it was a short answer would be time consuming. All of this faster out is right to equal that efficiency.

This is a the renovation ok is a limitation project to draw out for the start show. The answer is what he said. So, yeah, the idea is possible. But the idea is quite simple. If the number of object is huge, if the number of object is huge to the shocking process, it is shocking question. They make time consume for this case, because there is intersecting parliament ok so that is this one intercepting climate on a setting of economic. It accepted for that, exactly for that. It. So for this matters that can be crisis requirement.

So how profess how to address this case? If you have different requirements, suggest our results to a group, anyone can suggest that and improve the method in part. Yeah, a it's a potential passports which is a you come from the shopping local right? In a local manner instead of the local seven is an objective into multiple regions from the shopping. You have a local family instead of a global family, right? They go how many parts to settle? How many parts do you have to become? How many some regions right to country? It's a possible. It's a possible. So I so to address this is an issue.

The next afternoon, the kind of dance africa, the desks are from amazon. So that is the basic idea. So the basic idea is we can introduce one more part. We can introduce one more buffer. The buffer is the resolution, the same as the image resolution. Exactly the resolution is. It's the same as the image resolution. The depth buffer on the z buffer is used to start a picture with depth.

Ok we can start the dance information in picture ones ok we can start the pictures by the depths, because we start a picture depths. Picture, where is that? But that's information that we have compared. When we process one object. We can compare that if that's because the desk started the that's fine. We can do whether it's closer to the object of about, right? This is the idea is the kind of the bar that's probably like this. So this is massive and we require two products. Why is the frame buffer? The frame buffer is here to start a random image. Ok the frame property is used to start up the color equation ok but each to start up pictures, the zero that's wondering if you start up. The tax information is the tax was a distance information as a corresponding picture, ok and the response of pictures.

And so the tax part of the same resolution and a free bumper and start a tax situation, the back to the distance from the new client, the distance between a few parts and also of the visible. Yeah, but that's the value of the visible service and of the visible service.

The idea is, yeah, so ai use this example to show you the to show you the idea of this. And so we have, that's not her free buffer. This industry has to be seen, as the view, is that they hear, they are two objects. Ok the iq object is a distance. Why is it? Z equal to three? Why is it? Sorry, equal to five? The yellow object is a blue object. Ok also, we ask you to the object will be. So that second year for the blue object will be projected here, the yellow the project that be okay, as there is an election, that it's so the first time we initialize two buffers, the first time we initialize two powerful, we can initialize the dash problem is the last time we can initial the dash problem with a large value. It's a lesson here we initialize. That's part of the 999, right?

And for the free buffer is a paragraph O k for the Free buffer, we use the background color. Then we can. So this is the first time initialization. Then the next step is we have to determine the column. So that is a big Intelligence, the color on the three bottom. So which color can you use to pin some picture? Which color do you choose a red? Use the blue color, red as a yellow color to pick as a picture? Okay. Then that's we start from the little object. You can start from the yellow object. It's fine in this example, as we start from the blue object, ok the blue object of distance is far ok the distance while. And I mentioned earlier, that's the blue option to project here. And this is five.

The first time we will compare the distance between the the depth Information started. That's part. We will compare the distance of the object, which is that of starting, but that's not even the distance is smaller than the distance is started by. That's not. So we will update the best offer and also updated the Free buffer with the responding come.

Okay. Yeah, let's say so that this is five, right? So we assume the object will be projected in. Five is more than 999, right? So these four pictures, so is it for that locations in the desktop will be replaced with it? Far ok so if the best part is that if the best value is smaller than that study, xxl xxx xxx, xxx without the awesome. So the responding picture in the framework will be updated in this responding column for this one.

So this is for location. The dance Information will be updated. The color of that thing then. We can process the second the second object. The second object is that this yellow, the discipline is three on the back in the street. So as we assume that the yellow object will be, project is here that will be projected being, there will be compared to ask that this is for relations that three is smarter than five. This condition will be updated. And three is smaller. No. And this this history of teaching are updated, right? And responded in the fourier buffer. So therefore, pictures will be replaced yellow card. It will be replaced with yellow card. So this is the second. If they are more object, ok if there are more objects we just compare.

Is this example? We start from the yellow object, and I'm sorry, we start from the blue object. You can start from the yellow object. It's fine. You can start either not limited to not limited is the price option ok you can start coming easily. So that's if you start from the yellow ok right? It's a three, so it will be projected here, right? Three is a smaller than that. These are public choices will be replaced with the yellow partner as a gas matrix. This will be 3331. And then the blue object will be projected here. The family is smaller than 999, but for this picture, the desk Information is right. Five is a larger 13, so this picture will not be up here, will not be up here. And you can start from adding object. You can start from hanging out. It's not available to the five stars. Okay? So this means so this is somewhere some of the the whole process is the whole process. So that is we use, the key idea is we use a we use an additional desk product, we use an additional dash product to explore the dash mission.

In this way, we know the object in the near closest to the view. Online ok are you another word? Yeah. Actually, so you just mentioned that we can process themselves. We can process the debt shopping here locally, right? Yeah, actually, it's a process of localism. It's an extremely local just picture wise. Right? Picture west. So you just mentioned we can process the patch by patch 7 % and creative resolution. But this one is just a piece of ones for education ok there is a that short term is the partners of itself. We need an additional, we need an additional addition of that on the upper ground.

So that is overhead with you overhead. It will be as well. Nowadays, it is a majority of graphics and readers. The GPU is adopted as a oki thought as a buffer. The mindset is quite unique. It can handle it any case. Ok it has kind of energy. Also, we need a positive. We need a what about her? Yeah, it's fine. Part of the costly a lot of the cost in place. But all cases that we have. And this is the the evoke innocent of the global ads, 2 kinds of ads that is objects is diminish itself, is higher resources to becoming. Higher is visible, which time is it possible which I visible? And the image is based on this. And this actually is becoming a which kind of use, right? Which kind of use the penis picture, which is kind of in the picture, actually is based on business. Ok in the phase out of this is between the viewers and the object.

Addition to the the next step is of the Information model. Here. Probably I will introduce the formula emission model, ok the emission model after is a it's a farmer, it's fundamental, similar. It is a life action. It was simulated. So I asked you how to generate a lot like how to generate life is actually is the 3 kinds of reflections, 307. And if you reflections, permanent refraction and reflections, ok so ok so let's have a short read. There are many years of seven, the inefficient part of the trade investment.