Virtual Reality Engineering
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Lecture – 11
Human Vision (depth perception, cont'd)

Everyone, welcome back in the most recent lecture I explained to you. How the human eye works and we looked at the entire visual pathway from photoreceptors. Where the light hits going through the cells that are in front of the retina up to the ganglion cells and then communicating that information through the optic nerve and back into the visual cortex and we emphasize hierarchical processing that goes on and then once we understand that we like to start to talk about perception which is when the brain makes some kind of conclusion about what it is seeing or sensing if it is another sense beyond seeing and we gave examples of depth perception.

I gave you a number of examples of that we also talked about eye movements in the last lecture which are very important for doing things like keeping the image stabilized on the retina for a moving target or if you are moving your head or some combination of the 2. One thing to think about to continue from last time is on when we have various depth cues that I gave think about the combination of cues and I talked about many different kinds of cues.

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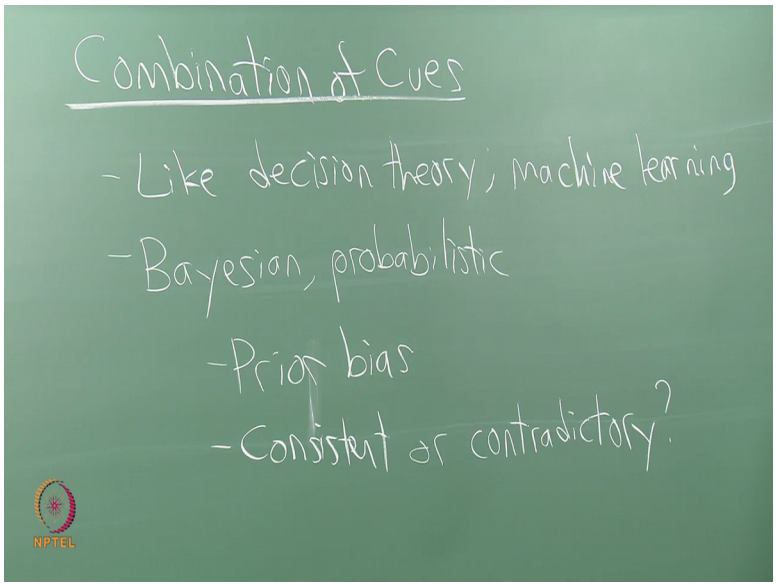

Like for example, one object is in front of another or you look at the overall size of the object on the retina. The size of the image of the object on the retina.

We looked at these things and the brain is taking all of these into account in order to make a judgement about depth. We also had what you would expect a binocular disparity rate coming from 2 different eyes, but I just want to emphasize last time through I think I gave a many examples almost a dozen examples of monocular cues which just used a single eye in order to make conclusions about depth.

In order to combine the cues one way to think about how this happens; it is very much like statistical decision theory which also shows up in machine learning. If you wanted to construct some kind of model of how the brain might be doing this perceptual psychology is very often like to consider it to be a kind of example of a Bayesian model Bayesian or probabilistic model and as such the brain is considering; how useful is each one of these cues.

In the particular, context where it is being observed what are the priors the brain is using a lot of information about priors given the context if I been out on the forest many times in my life and then I go out on the forest again there are a lot of expectations of what to see around there? You will not see a um bunch of cars you know driving right through the middle of the forest or something let us say or you know something completely absurd. Suddenly, appearing in front of you in the forest there shouldn't expectations about the context your brain is filling in the this information in some ways trying to reconstruct a full picture without having requiring additional information or additional sort of reasoning power.

It is falling back on priors very often these are some things that are very important for a Bayesian modeling and analysis and this seems to happen as well in the human vision system. There is prior bias your biased by the expectations of what you see and in the process of putting together information from multiple cues the brain is trying to decide whether that information is consistent in which case it will increase your confidence in what you are seeing or is it contradictory.

It is contradictory, it will lower your confidence and when we see some of these optical illusions, they may contain contradictory cues and this causes some significant amount of confusion.

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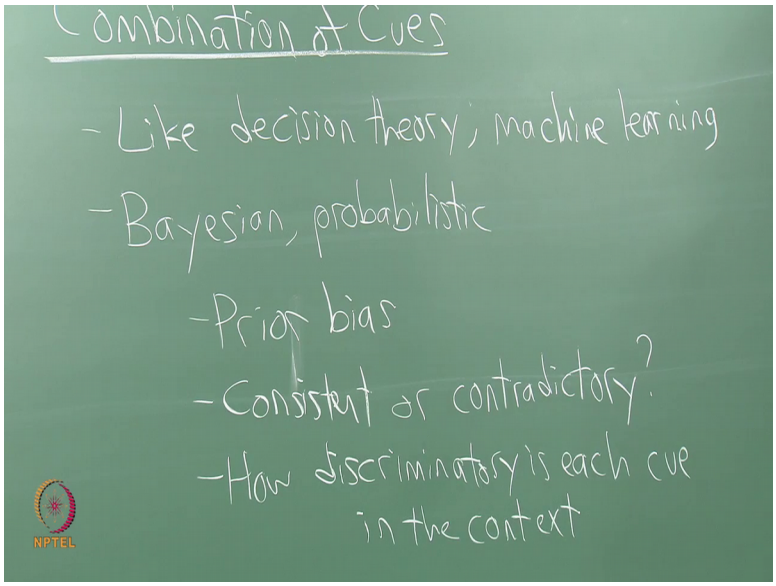

How useful or how discriminatory? Let us say is each cue in the context, context could be in combination with all of your other senses and your memory of what place is like whatever you are seeing I have appeared like before all such as one extra thing I wanted to add to the depth perception and this generally applies to all aspects of perception. These kinds of ideas here and not only combining multiple cues from the same sense, but also combining information from multiple senses to make some kind of coherent view of the world with a very high amount of confidence.

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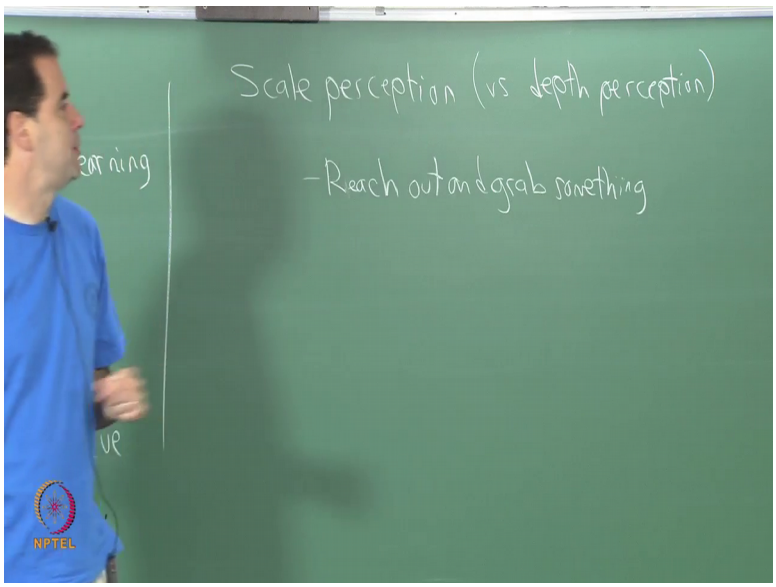

Whether related topic which I will not cover very much, but you can also talk about scale perception and compare that to depth perception.

How large is the object? That I see if you make a virtual world and you start putting furniture in there. Does this correspond to furniture that you seen before? Is it just look kind of vaguely similar like maybe there is some kind of sofa chairs appearing well based on the way the chairs look? You might be able to estimate how large it should be, but also the depth perception is coming into play again. How far away is this object right is it that the objects very far away and enormous or is it up closer and smaller.

You can see that depth and scale are very closely intertwined these are very important a aspects or concepts for virtual reality because, maybe you would like to reach and grab something if you are tracking your hands. For example, even if you are not tracking your hands you may still have a simple some kind of simple controller interface, but you want to with your virtual arms reach and grab something.

How perception of depth and scale come together will be very important in a context like that right and as well your perception of scale and depth are going to be affected by your interpupillary distance in the virtual world that is another interesting thing right we talked about that.

If I put your eyes very, very close together in the virtual world you what you may perceive yourself as smaller or perceive the outside world as larger you can think about that very, very philosophically if you want they more or less the same thing geometrically. How does your brain choose and interpret that when you in some kind of virtual world it is very difficult to say it probably depends on the amount of realism.

If the virtual world looks very much like some familiar physical place then if you make the IPD very small you will most likely feel small in that world if you make the IPD very large you will most likely feel large in that world if it is a completely synthetic cartoon like world it is very difficult to say what will happen? What your; how your brain will interpret them make questions about this.