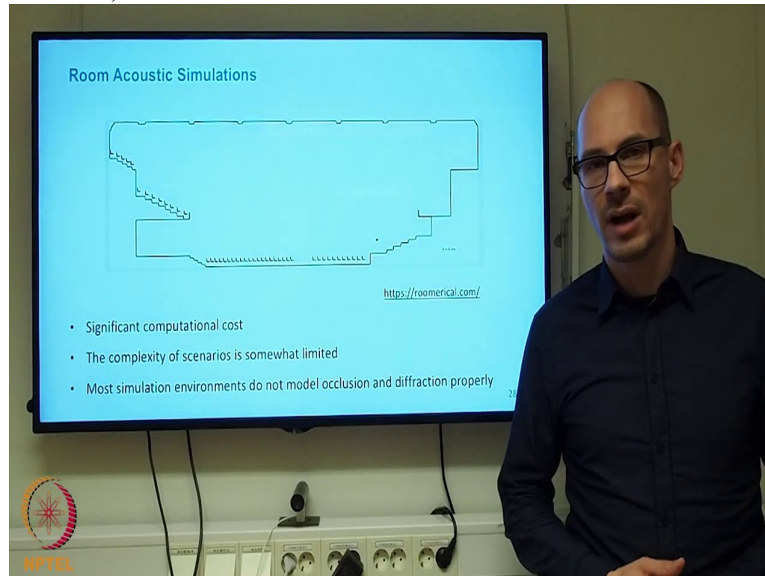**Audio for Virtual Reality**
Professor Jens Ahrens
Division of Applied Acoustics
Chalmers Institute of Technology
Closing Remarks

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I would like to wrap up this chapter on Audio for Virtual Reality with another challenge that is apparent when producing, when rendering convincing audio for virtual reality which is the rendering of the acoustic response of the virtual environment in which the virtual scenario is taking place.

So any object that is apparent in that scenario be it a virtual building or a wall if it is an indoor scenario or the floor or the ceiling of a room has an influence on the sound flow that the sound source radiates. And usually this, the room response is termed reverberation.

And this reverberation needs to be added to the sounds in a virtual scenario because if this is not done then a virtual sound source might appear too close or it might stick out in some way that is undesired. So what one needs is reverberation that appropriately represents the acoustics of the environment in which the scene is taking place.

Unfortunately this is very complicated operation and there is no ultimate solution available. There are many solutions for many, for certain restricted scenarios but the one and the only golden method is not available yet at this point. When the scenario then one wants to handle

is at least not that super simple, one will have to simulate the acoustic of the environment but one cannot guess it.

To do, doing this is very costly. And many of the simulation frameworks, they do not take certain wave phenomena into account

For example occlusion and that is, if there is an object between a sound and receiver, between a sound source and a receiver and that causes diffraction so sound waves, they bend around corners at, under circumstances and for convincing reverberation this has to be simulated.

There is only very few frameworks in the world, simulation frameworks that can do this. One is provided by Roomerical of which I have an example here. This is a movie which I will show shortly, an animation.
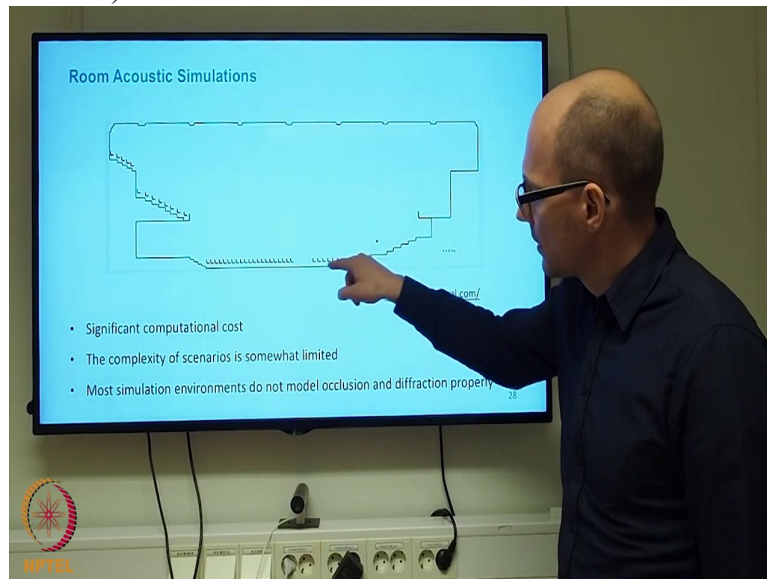
This is a vertical cross-section through a concert hall, there is a sound source
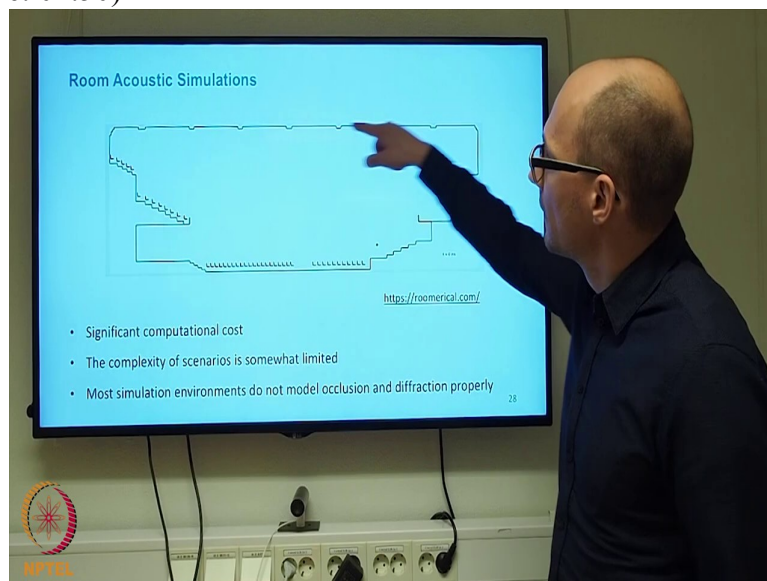
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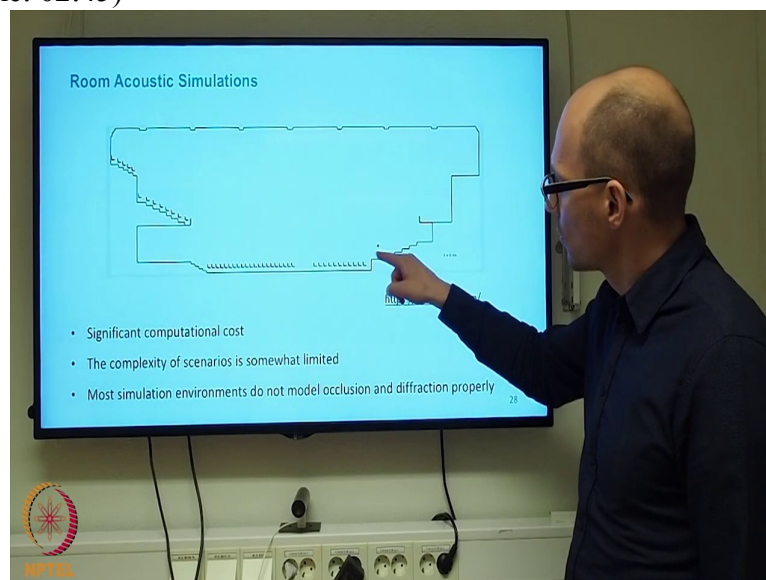
on the virtual stage and all these

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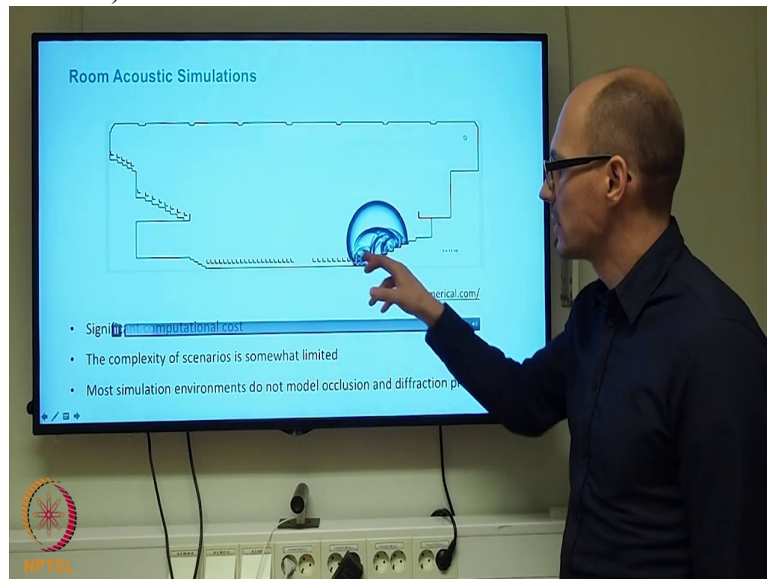marks they represent seats in the audience area

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and there is also some geometrical details inside the ceiling
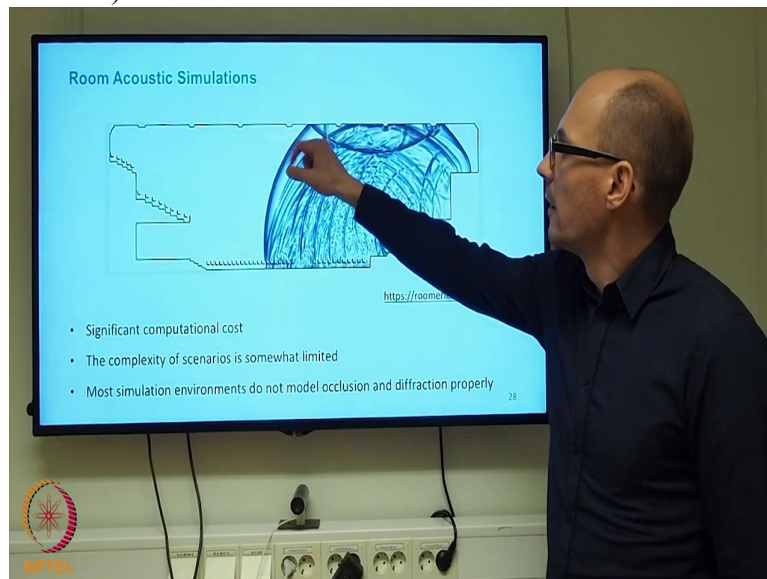
And if the sound source now radiates a sound,
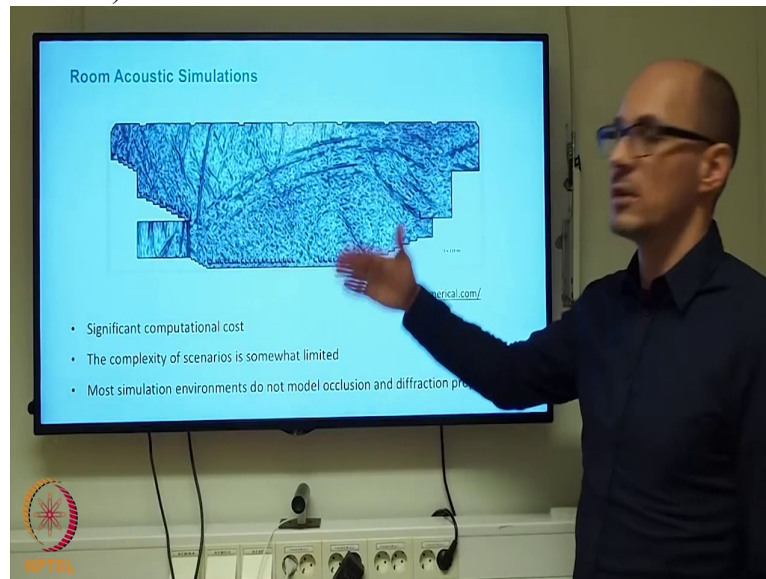
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you can see the wave as it propagates, it is of course influenced by all the objects inside

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the room, even these little details, the ceiling they influence the sound and they reflect and diffract

the sound.

And of course, the reflections they get reflected again and eventually very complicated reverberation evolves and you can now see, when seeing this you can guess that this is fairly complicated to do and also scenarios of a certain complexity can be handled

Meaning some scenarios, some rooms that are too big or too detailed, they cannot be handled in practice because of computation also numerical issues. There are fundamental limitations in this.

So this is kind of what is going on currently and the ultimate solution that might be available at some point will somehow relate to this but unfortunately is not available yet and there is probably many years that have to come for this to happen.

So please stay tuned and stay curious and browse the web for the latest news on audio for virtual reality. Thank you very much for your attention.