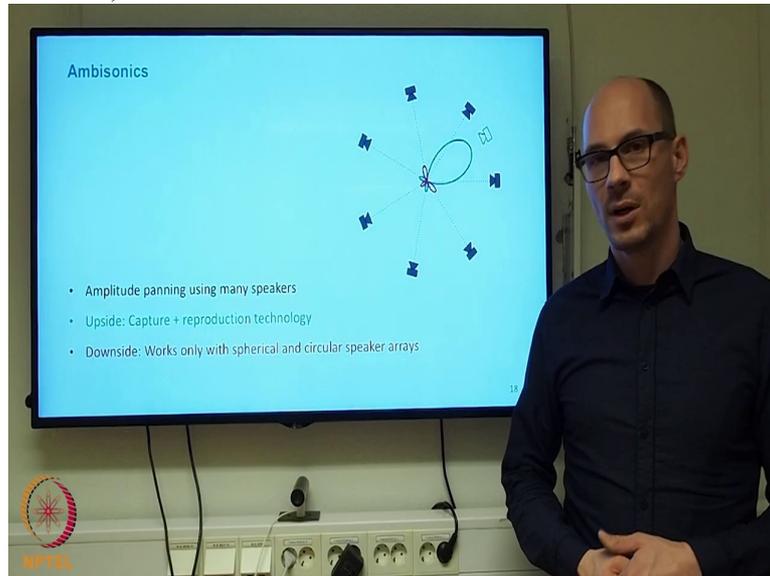


**Audio for Virtual Reality**  
**Professor Jens Ahrens**  
**Division of Applied Acoustics**  
**Chalmers Institute of Technology**  
**Ambisonics**

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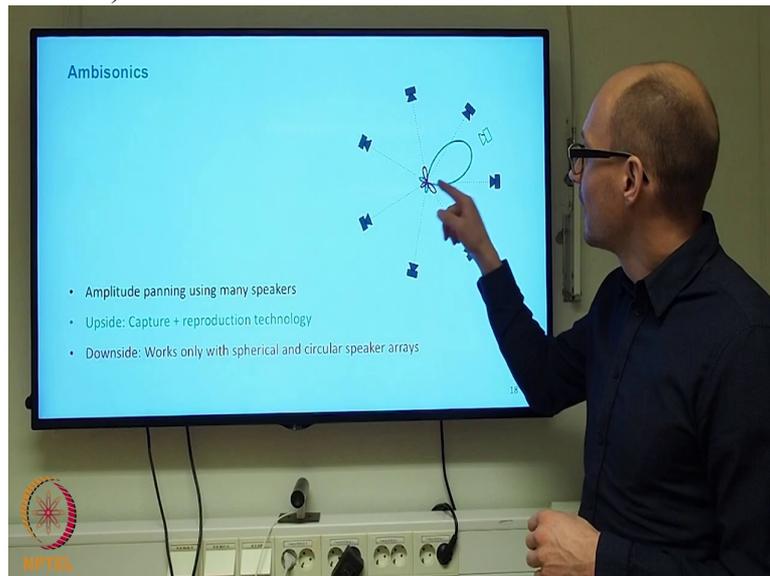


What else can we do? Well, we can use more loudspeakers than the stereophony. For example we can, we can distribute loudspeakers on a circle and then use what is referred to as ambisonics.

A word of warning, ambisonics is not one single method but it is actually a, a family of methods. And the example that I have shown here is the simplest and there is also more advanced one

And what they all have in common is the idea that all loudspeakers that are apparent for example on a circle or spherical arrangement, they produce the sound field

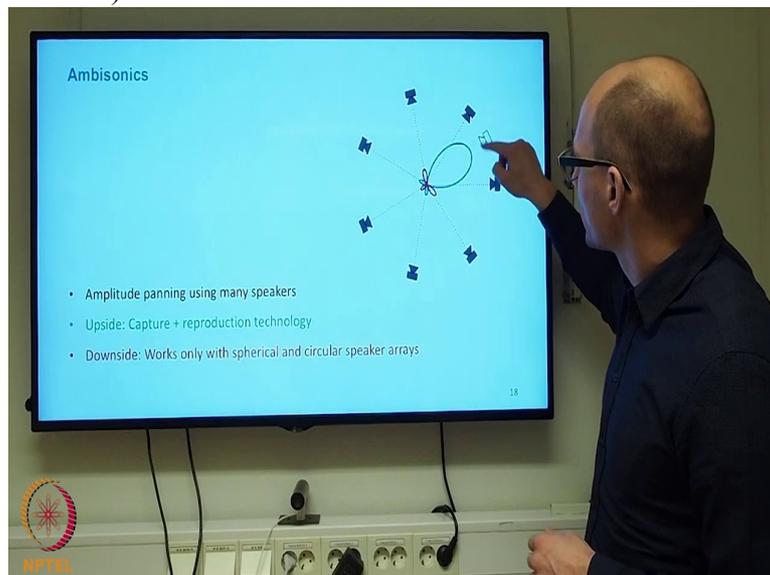
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that has the desired propagation direction at the center of the arrangement.

So that for example, if you were to render a virtual sound source

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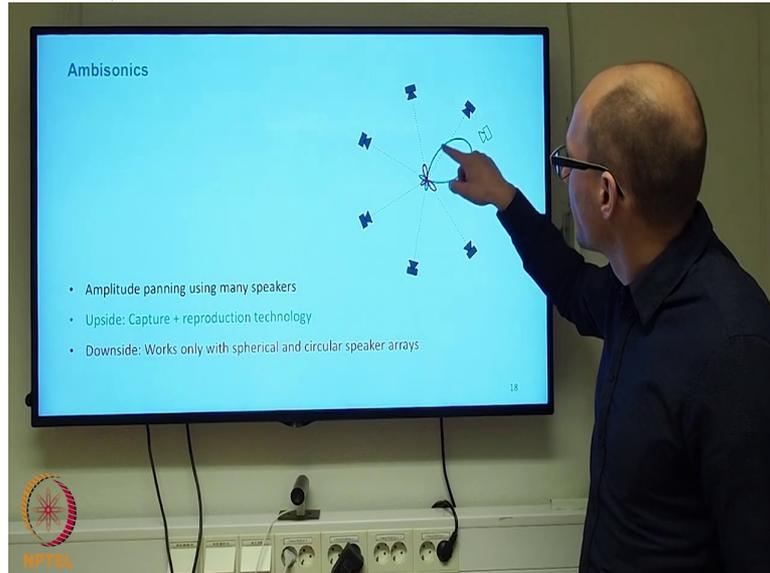


here you would use all loudspeakers to produce a sound source, a sound field that propagates in the same direction like the sound field of that virtual source would propagate.

You can already see the downside. The user has to be located at the center. A certain variant of this is ambisonics amplitude panning which is what is illustrated here.

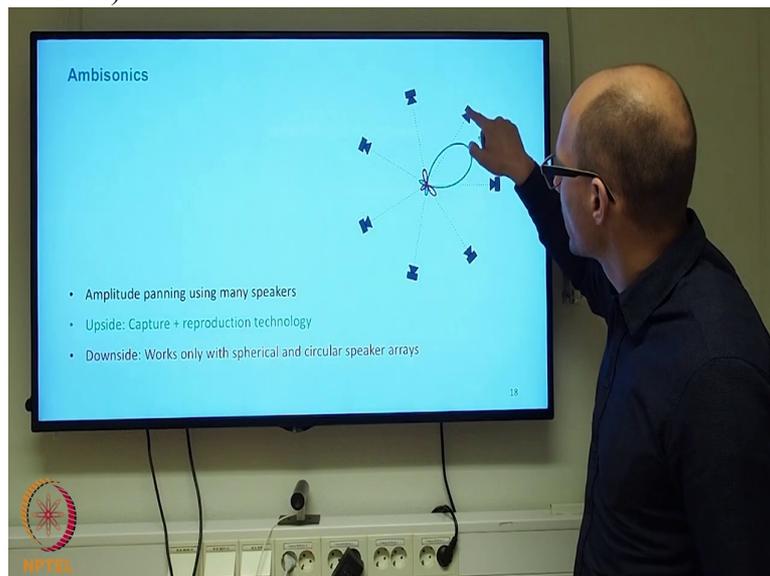
And these,

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this colored curve illustrates the panning law so the amplitude panning law, and if where ever the line connecting the center

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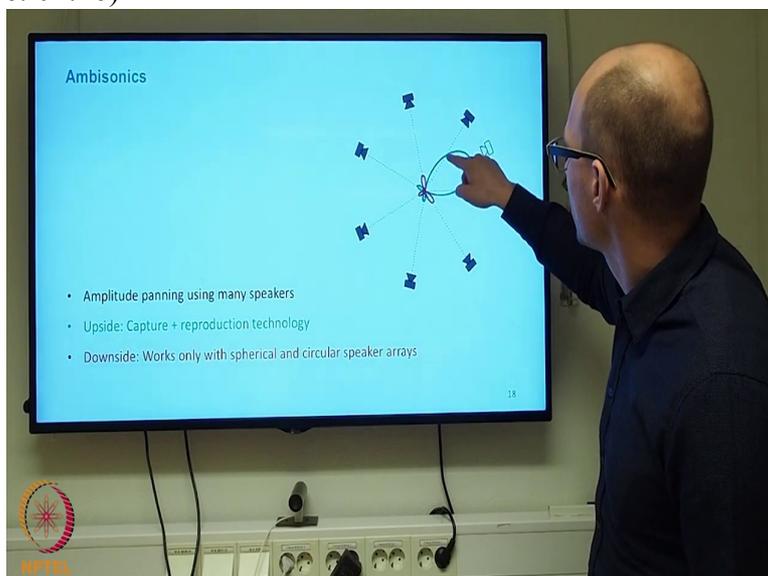


of the arrangement and a loudspeaker intersects with that panning curve, this determines the gain for the loudspeaker, the amplitude for the loudspeaker signal, for the signal that the specific loudspeaker has to radiate.

Blue color in this case means positive sign and red color means negative sign. So it is in this indeed such as in this case that different loudspeakers may radiate the same signal with opposite algebraic sign but the timing there will be no, this case there will be no timing difference between the loudspeaker signals.

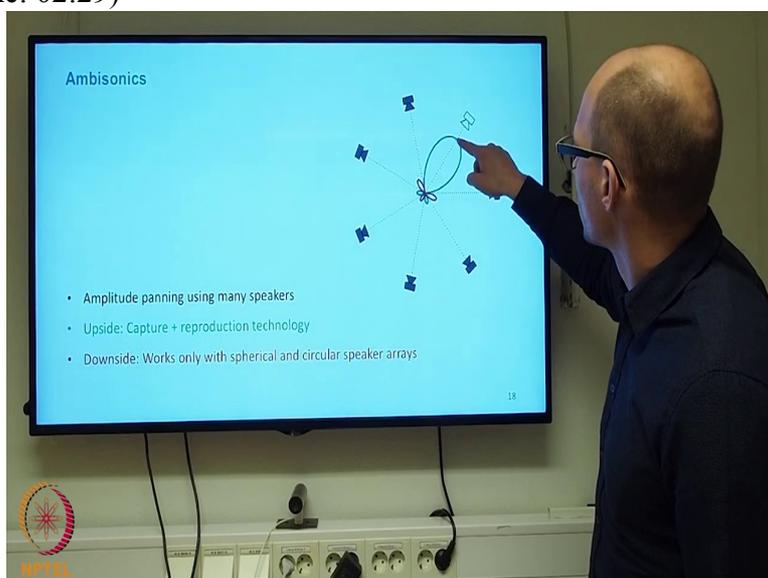
So if you are looking at different source positions, if you make the source move

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you will see that the amplitude of the loudspeaker

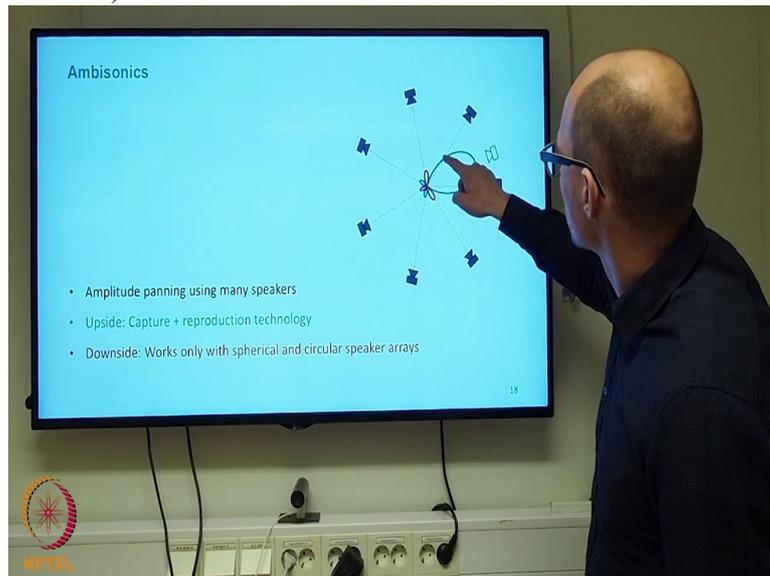
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changes accordingly over the time.

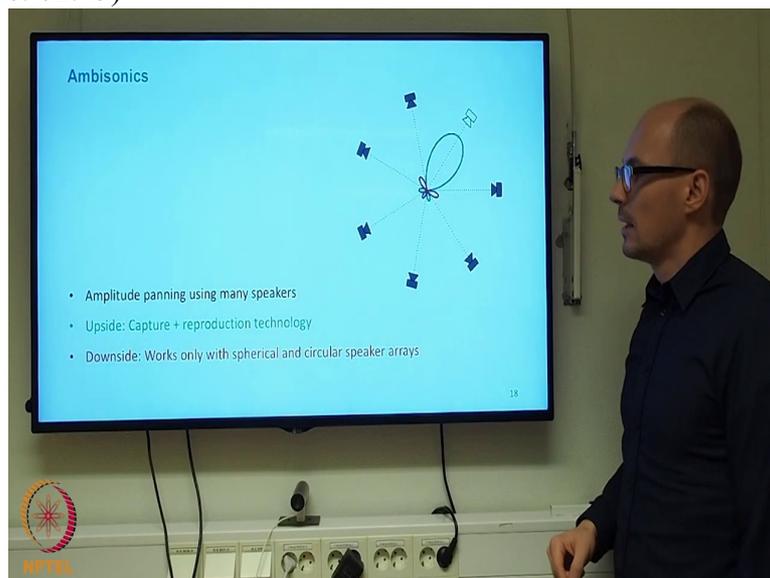
So let us look at this loudspeaker, excuse me. It starts at fairly low amplitude and

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as the source comes closer the amplitude increases and similarly the amplitude

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signal that the other loudspeaker radiates changes accordingly,

So the upside of this is that first of all it does not have this angle restriction like stereophony. And it is more robust than crosstalk cancellation and also there is a way to record sound scenes as such that you can directly obtain the loudspeaker signals such that the spatial information of that sound scene that you captured with this microphone array is readily available. I will speak about this capture method at the very end of this chapter.

The downside is that it does not work well with loudspeaker arrays that are not spherical, or circular and the listener to be located at the center of the arrangement.