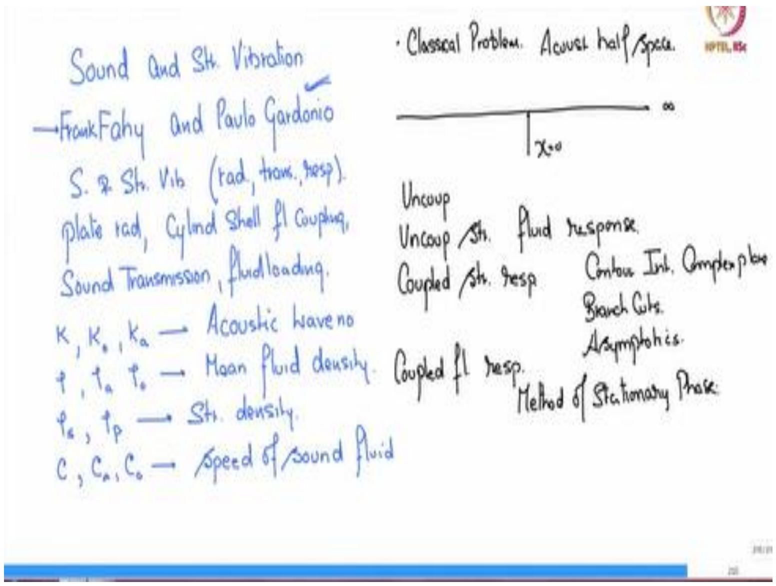
Sound and Structural Vibration
Prof. Venkata Sonti
Department of Mechanical Engineering
Indian Institute of Science, Bengaluru

Lecture - 60
Summary of the Entire Course

(Refer Slide Time: 00:44)



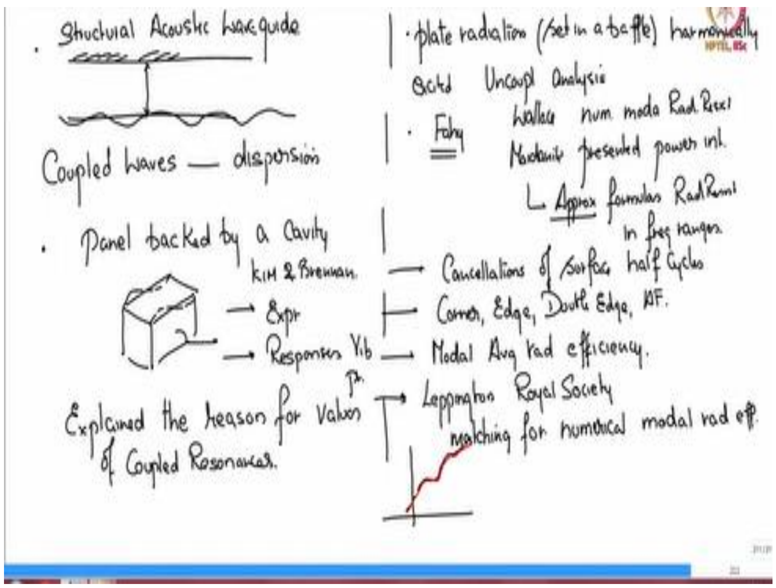
Good morning, you have been seeing lectures on this topic sound and structural vibration. Let me say in the beginning a few things I have been following more or less this book by Frank Fahy and Paulo Gardonio. In the book is a similar title sound and structural vibration, radiation, transmission and response. Portions of plate radiation, portions about cylindrical shell and coupling, fluid coupling, entire portion on sound transmission and the; last portion on fluid loading.

I took from this book as I said there is an expanded version now with a co-author. Now I have more or less stuck with standard notation. So, I have used k, k_0 and k_a mostly for the acoustic wave number. I have used ρ, ρ_a and ρ_0 for the mean fluid density. Then I have used ρ_s for structure sometimes ρ_p for plate sometimes as the structural density. And lastly, I have used C or C_a or C_0 for the speed of sound in the fluid.

So, what did we cover? We covered a classical problem. We call it classical because it is an infinite domain and there are many things to learn from it. So, there is an infinite 1D plate driven by a line force at $x = 0$ interacting with an acoustic half space. So, we looked at the uncoupled waves first of all the uncoupled response, structural response and fluid response. Then we look at coupled structural response. Here we used contour integrations in the complex plane.

We required the knowledge of branch cuts then we needed the coupled roots. So, we used asymptotics to find the coupled routes. Then we looked at the coupled fluid response and we required the method of stationary phase.

(Refer Slide Time: 05:53)



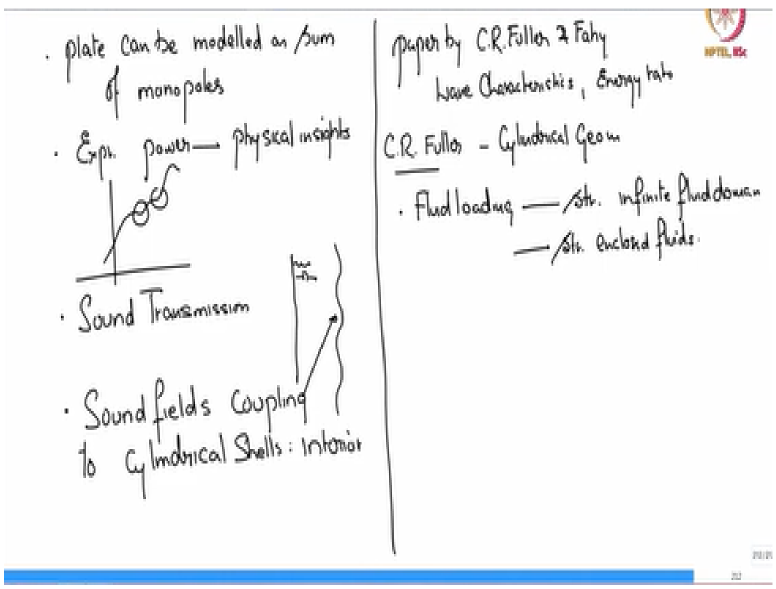
Then the next problem from all infinite domains we went to a structural acoustic waveguide. So, a column of fluid with a rigid plate on the top and a flexible plate at the bottom. We looked at the coupled dispersion curves coupled waves through the coupled dispersion curve. Then we looked at a panel backed by a cavity. So, there is this panel that is vibrating, and it is backed by a cavity this panel vibrates. So, we looked at a paper by Kim and Brennan.

So, we derived expressions and we looked at responses that are vibration and sound pressure. Then we explained the reason for values of coupled resonances. And this was followed by plate radiation and plate is set in a baffle and harmonically excited and an uncoupled analysis. So, this as I said, I took a lot from the book by Fahy. And then we looked at papers by Wallace who numerically computed modal radiation resistances.

Then we looked at a paper by Maidanik who presented a power integral in a unique way. So, we derive that integral. Then he makes approximations and gives formulas for radiation resistance in different frequency ranges. And he is the one to discuss cancellations of surface half cycles and discuss corner modes, edge modes, double edge modes, acoustically fast modes. Then he also presented modal average radiation efficiency which I showed you how to start the derivation.

Now in this regard there is another paper by Leppington which is very useful. It is a royal society paper they almost give a matching formula. They compute matching formulas for numerical model radiation efficiencies. It is very mathematical. What do I mean? I mean if Wallace computes his radiation efficiency or radiation curve then Leppington computes a closed form formula that matches like this. But it is very mathematical because it is whole lot of asymptotics and so forth.

(Refer Slide Time: 11:50)



Following this we looked at how plate can be modelled as a sum of monopoles. So, we gave an expression for power or intensity, and it has some physical insights how cells interact and interfere and give you those oscillations in Wallace's numerical curves these oscillations. We followed this by sound transmission of initially a rigid infinite partition mounted on springs and dampers. Then an infinite flexible panel with a plane wave incident at an angle.

Then we looked at sound fields coupling to cylindrical shells, mainly interior. And in this regard, we looked at a paper by Fuller and Fahy that discusses wave characteristics in coupled cylindrical shell fluid systems and also presented a calculation for energy ratio. There is a lot of work by Fuller in cylindrical geometries if you are interested. Then lastly, we discussed the topic of fluid loading in structures that radiate to infinite fluid domain and structures that carry enclosed fluids. So, that was the entire course. Thank you.