Structural Health Monitoring (SHM)
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Lecture - 66
Application of SHM in Infrastructure Engineering-Part 2

There is no look at the complexities of implementing the machine learning approach.

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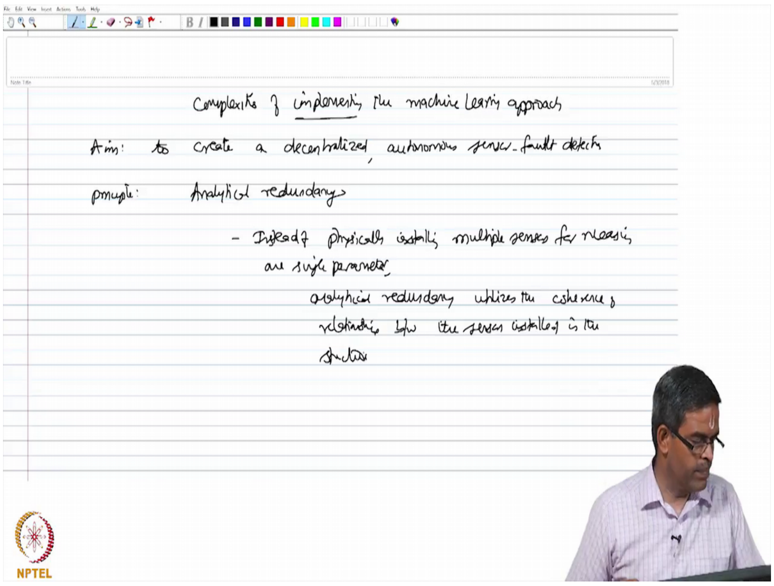

As I said in the beginning the aim was to create decentralized autonomous sensor fault detection, the principle used here should be analytical redundancy. So, what we do is instead of physically installing multiple sensors, for measuring one single parameter analytical redundancy utilizes. The coherences and relationships between the sensor installed in the structure. I can give an example here, a very clear applied example.

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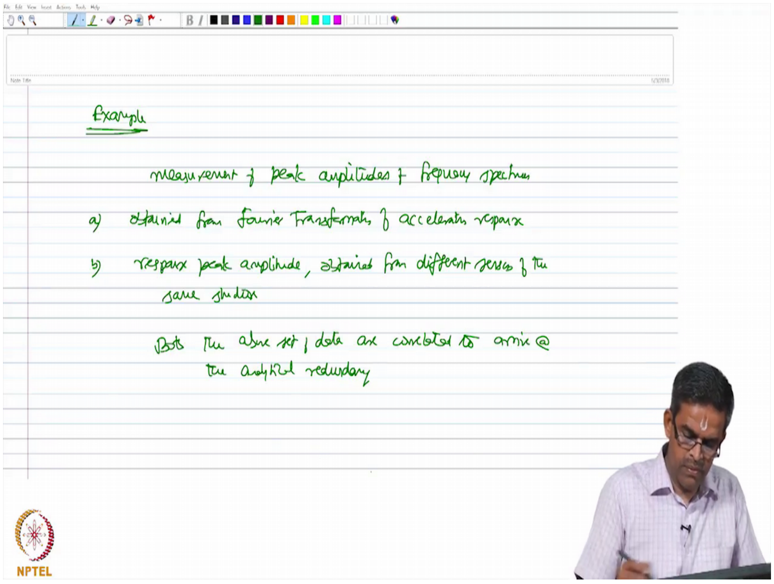

Is measurement of peak amplitudes of frequency spectrum: a one value is obtained from the Fourier transformation of acceleration response. The other one is response peak amplitude obtained from different sensors of the same structure. So, both these data's are correlated to arrive at the analytical redundancy.

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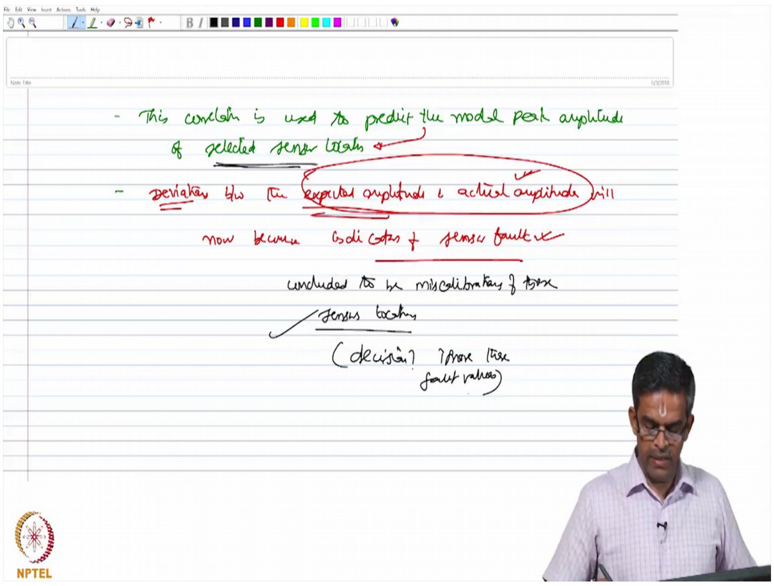

Then this correlation is used to predict the modal peak amplitude of selected sensor locations. Now, interestingly the deviations between the expected amplitudes and actual amplitudes, expected amplitudes are actually predicted from the correlation on chosen selected sensor points.

So, there will be some deviation between these predicted amplitudes and actual amplitudes will be measured by the sensors and they will now act, will now become indicators of sensor fault. If you look back the objective was to prepare the decentralized, autonomous, central for deduction. So, one can easily find out by looking at the deviations between these two data.

The sensor fault detections can be easily indicated and this can be concluded to be miscalibrations of those sensor locations which are chosen we have chosen some sensor location they are considering miscalibrations. So, in that case what will the decision the decision could be ignore these fault values, that is why it is called analytical redundancy now in this whole process?

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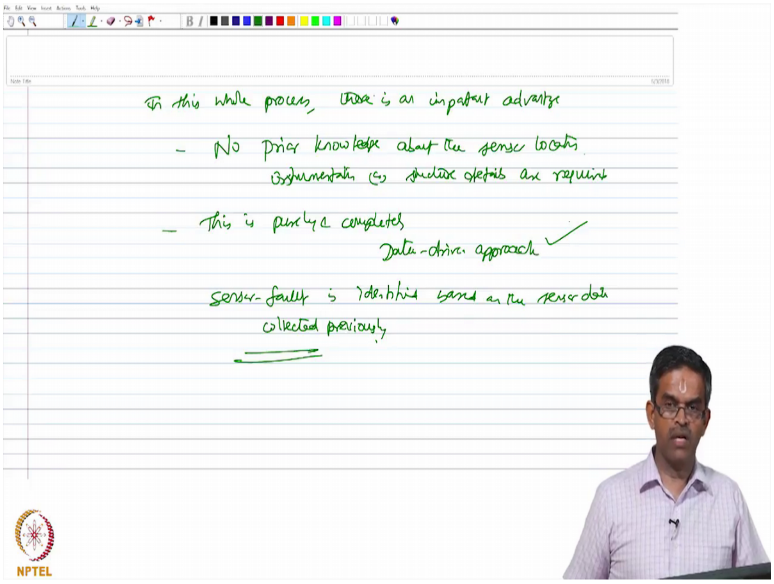

There is a great advantage the advantage is no prior knowledge about the sensor location, instrumentation or structural details are required. This is purely and completely data driven approach isn’t, not we, do not looking for any physical approach problems at all. So, the sensor fault detection is identified based on the sensor data collected previously that is the beauty.

So, it is purely based upon data driven approach it is not based on physics approach which otherwise is computationally expensive as far as structural health monitoring is concerned.

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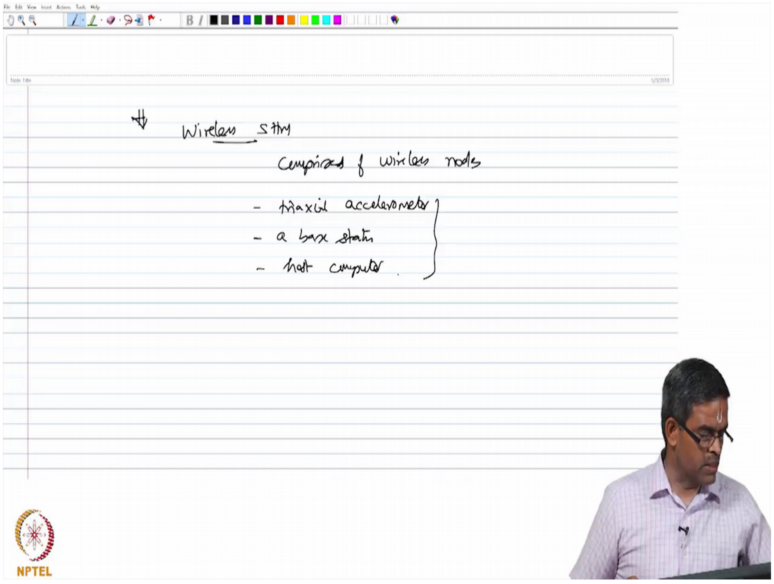

Let us extend this algorithm further down to wireless sensor networks, wireless SHM comprises off we know wireless nodes, maybe it may contain triaxial accelerometer, a base station and a host computer. Let us look at the monitoring task of this example let us say there are couple of sensors which are measuring a couple of sensors located.

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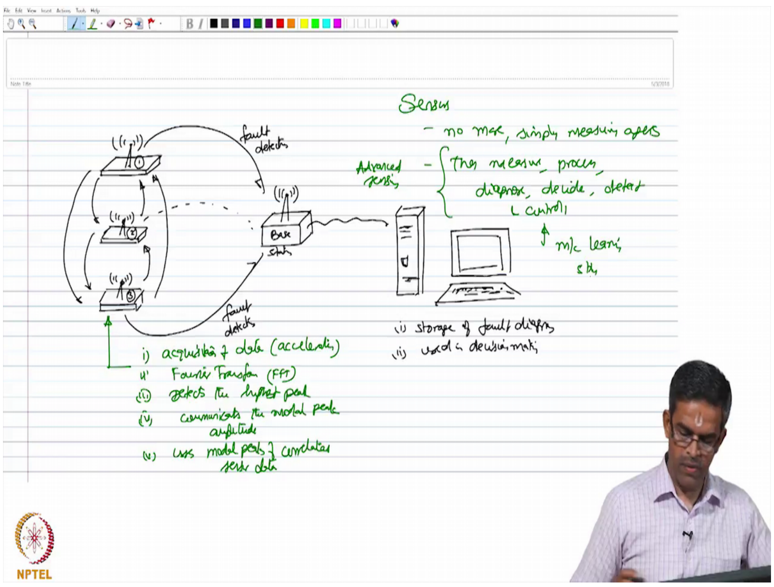

Now, interestingly these sensor nodes for example, let us say this is node 1, this is node 2, and this is node 3.

They interconnect and communicate with each other, further they also communicate to the base station, through radio frequency now each one of them also communicates the fault detection results further from the base station. It is communicated to the host computer where storage of fault diagnosis happens it also is used in decision making.

Interestingly let us see what are the job performed by each sensor each sensor performs various jobs, acquisition of data may be acceleration because we are taken an example of triaxial accelerometer. It also does Fourier transform of the data, it further detects the highest peak it then communicates the modal peak amplitude because it is frequency dependent now.

It also uses modal peaks of correlated sensor data for useful prediction. So, now, friends please understand sensors are no more simply measuring agents they measure process, diagnose, decide detect and also sometimes apply control. So, they do very intelligent jobs that is what we call this as advanced sensing technologies, and that is the part of machine learning which becomes very important in SHM. So, we can have additional reading on this topic.

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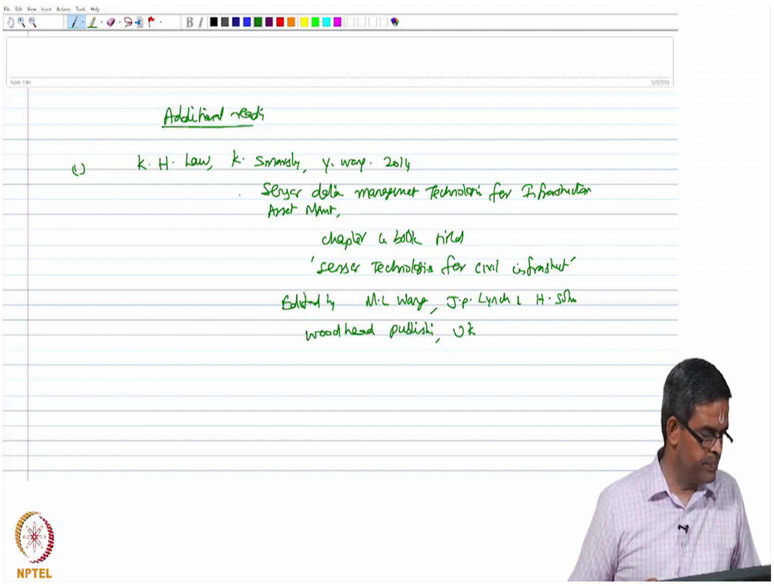

One can be K H law, k smarley y wang 2014 sensor data management technology, for infrastructure asset management. The chapter in the book title Sensor Technologies for Ccivil Infrastructure edited by M L wang, J P lynch and H Soham which is put head publishing UK.

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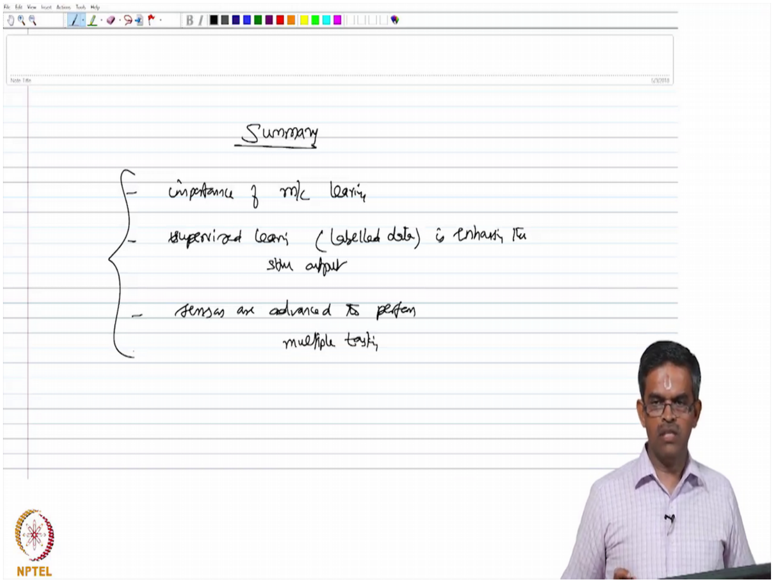

So, friends as a summary for this lecture we understood the importance of machine learning, we also said how supervised learning that is labeled data is enhancing. The SHM output we have also seen how sensors are advanced to perform multiple tasking. So in the further lectures, we will talk about application of these structural health monitoring systems on offshore structures essentially on lab scale.

Thank you very much and bye.