Structural Health Monitoring (SHM)
Prof. Srinivasan Chandrasekaran
Department of Ocean Engineering
Indian Institute of Technology, Madras

Lecture - 67
Design of sensor layout for SHM -Part 1

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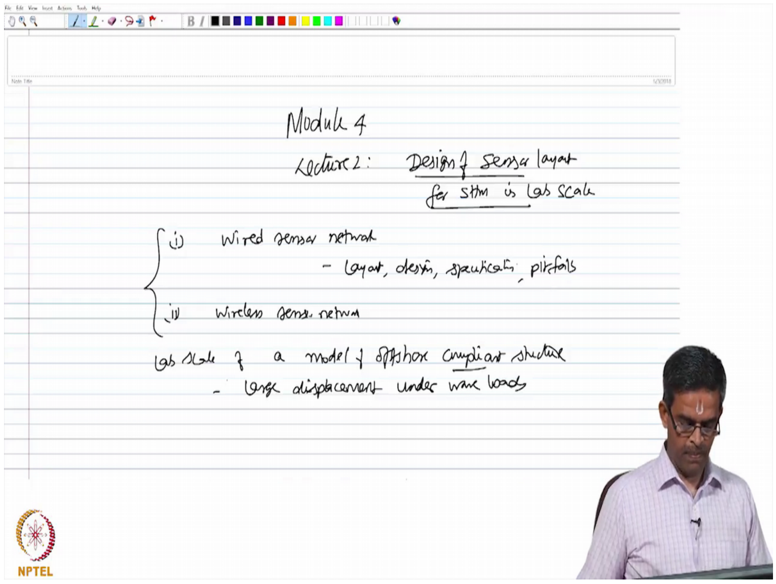

Friends welcome to the second lecture in module 4. We are going to talk about the Design of Sensor Layout, for Structural Health Monitoring in Lab Scale. We will talk about the complete design of two issues here: one a wired sensor network, we will talk about the layout, a design, specifications, and pitfalls. We will compare this with wireless sensor network, both are played on a lab scale of a model, of offshore, compliant structure, complaint structure is chosen, because it under goes large displacement under wave loads.

So, that becomes easy for us to essentially use the existing available sensors for a wide range of frequency, which can be useful to capture the measurement data of the scaled modal.

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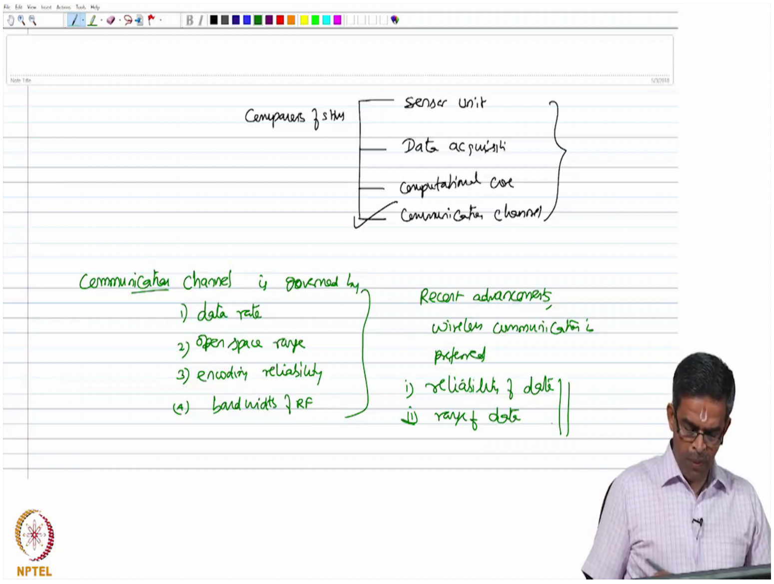

Friends if we recollect in the previous module one of the lectures. We discussed that components of SHM or essentially a 4, which will be the sensor unit, data acquisition, computational core and communication channel. While the details of all these 4 modules as components of SHM has been discussed earlier. In one of the lectures in module 3, we will slightly highlight an important issue, for reiterating the connectivity of the design and layout of sensors for health monitoring in the present case study.

So, we wish to talk about the communication channel slightly more in detail. The communication channel is governed by, the data rate, open space range, encoding reliability, and bandwidth of radio frequency. These are the vital parameters which governs the design of an communication channel. We all do agree with that with the recent advancements, people prefer to use wireless communication, whereas the main parameters in wireless communication would be the reliability of the data transfer and, the range of data that is a space constraint.

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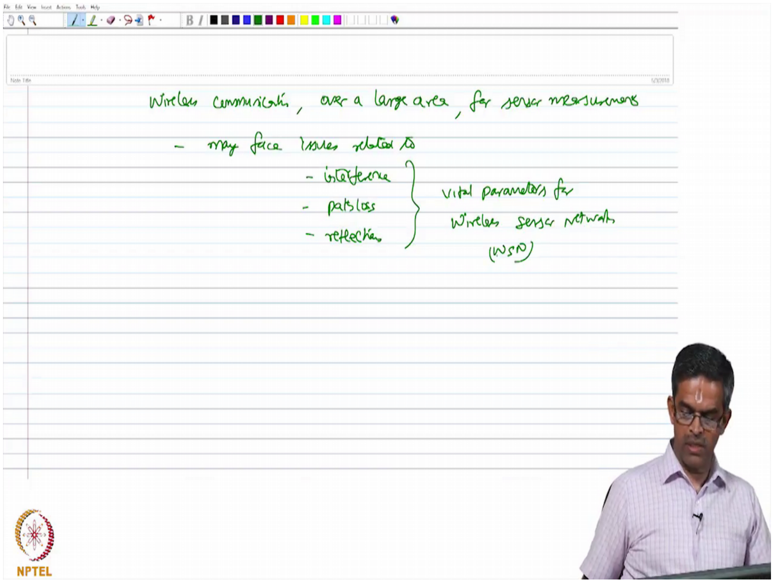

It is very important that wireless communications, when spread over a large area, especially for sensor measurements, may have or may face issues, related to interference path loss reflections which now, become the vital parameters for wireless sensor networking which we will abbreviate as WSN in the further part of this lecture.

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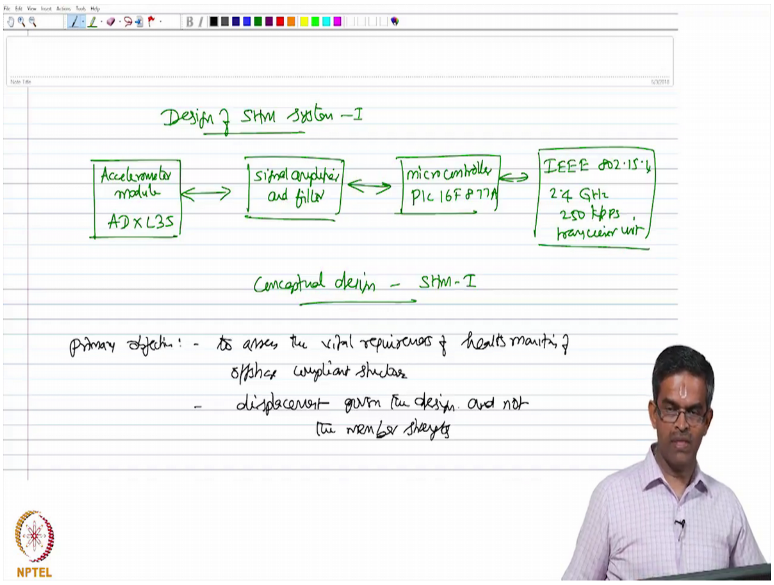

Well now talk about the design of the SHM layout, I call this as system one. The system one consists of accelerometer module, which essentially is a commercially available accelerometer which is a A D X L 35. Now, this is connected to the signal amplifier and filter, this is further connected to the microcontroller, which is the processing unit in our case it is PIC 16 F 877 A, which is by enlarge now connected to the communication channel, which is I triple E protocol 802 15 4, which is locally available of 2.4 gigahertz speed, 250 kbps trance receiver unit.

So, this is my conceptual design now, this is how the SHM 1 will be laid ok. So, the primary objective of this design is to assess the vital requirements, of health monitoring, of let us say offshore compliant structures. The beauty about this is displacements govern the design and not the member strength, displacement govern the design, because the undergo large displacement and not the member strength. So, one is not interested physically to measure the stress and strain on the members cost because of accidental loads, but one is now interesting rigid body motion, in various degrees of freedom exercised on the modal, when wave is acting upon the modal.

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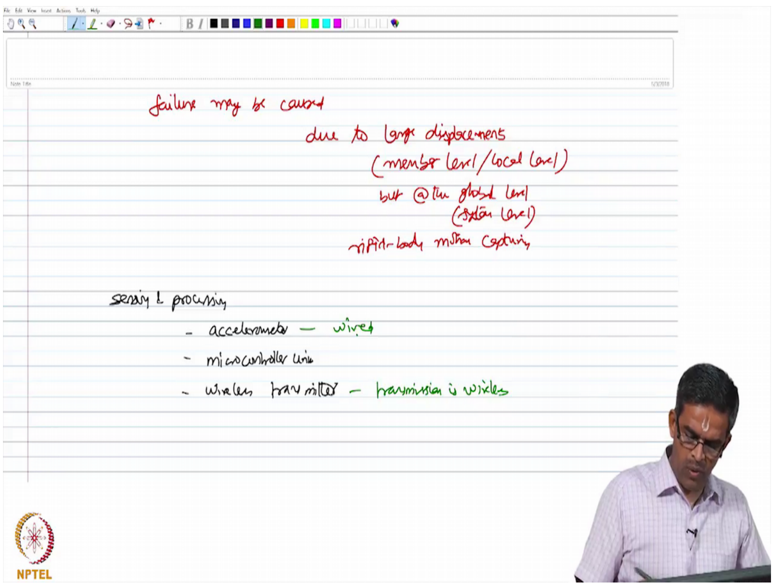

So, here failure may be caused, only due to large displacements and that too not at the member level that is not at the local level. But at the global level that is at the system level ok. We are looking for essentially a rigid body motion capturing ok. So, in the design sensing and processing, consists of an accelerometer, microcontroller unit and, your wireless transmitter.

Now, please understand here the transmission is wireless, but the measurement data will be wired, adding to one more point.

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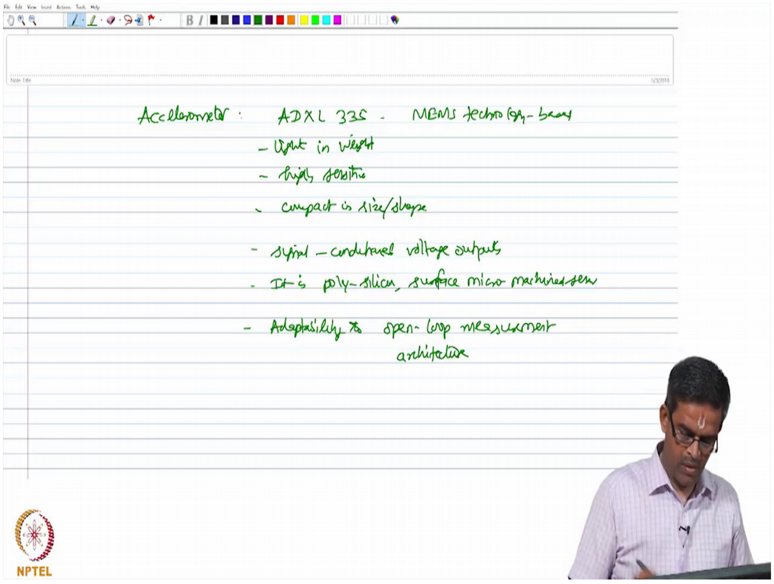

The accelerometer used in the study is ADXL 335, which is MEMS technology based. It is light in weight and highly sensitive compact in size shape. It has got signal conditioned voltage output. So, there is no additional process required to get the measurements clear, it is essentially a poly silicon, surface micro machined sensor ok. This has adaptability to open loop acceleration measurement architecture.

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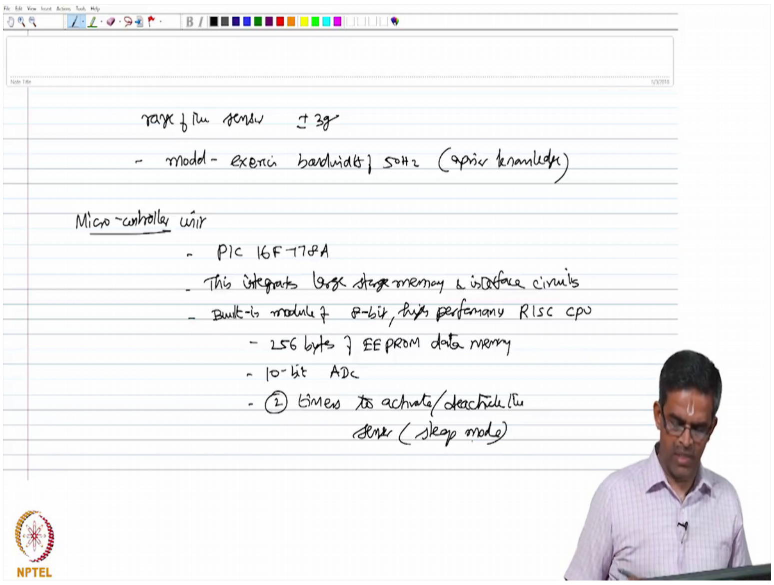

Of the sensor is plus, or minus 3 g of course, the modal is going to exercise your bandwidth of about 50 hertz. So, that s an aprior knowledge, which is known from the analytical studies conducted earlier ok.

The microcontroller unit used in the design is PIC microcontroller 16 F 778 A, this integrates large storage memory and interface circuits. It has got the built in module of 8 bit high performance RISC CPU, which features 256 bytes of EEPROM data memory, a 10 bit analog digital converter. And of course, 2 timers to activate, or let us say deactivate the sensor, that is to put the sensor in sleep mode for power saving.

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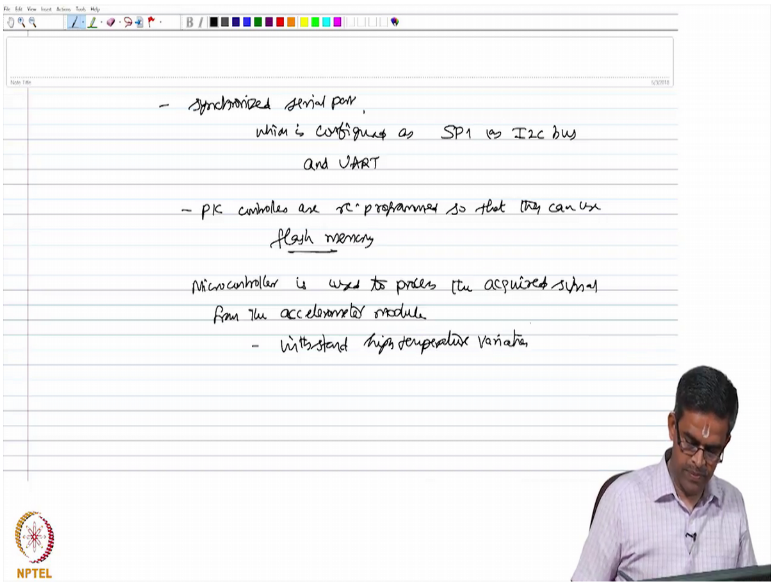

It has got a synchronized serial port, which is configured as serial port 1 or I 2 C bus and UART the PIC controllers are reprogrammed so, that they can use the flash memory. The microcontrollers are used to process, the acquired signal, from the accelerometer module, which can also withstand high temperature variation.

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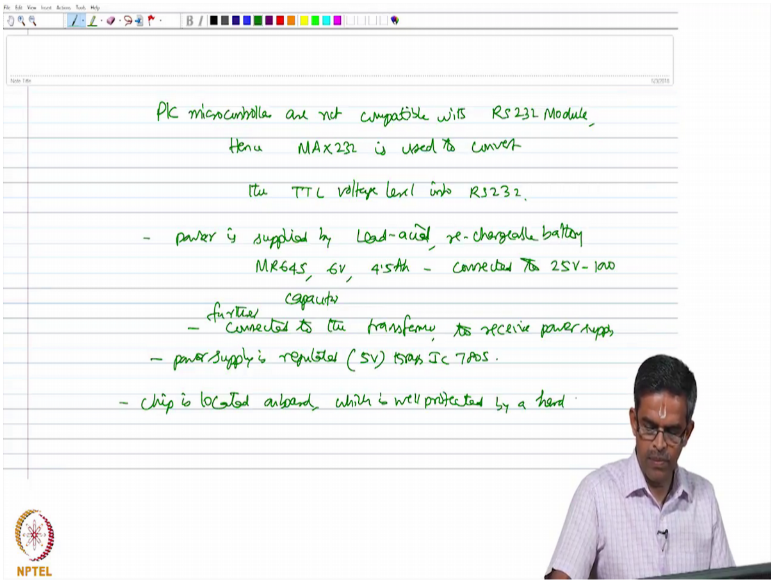

Now, interestingly the PIC microcontrollers, generally are not compatible with RS 232 module. Hence, MAX 232 is used to convert the TTL voltage level into RS 232 the power is supplied by a lead acid battery, rechargeable battery, which is MR 645 6 volt 4.5 ampere hertz, which is connected to 25 volt 100 1000 of capacitor.

This is further connected to the transformer to receive a power supply, the power supply is regulated, which is 5 volt through IC 7805 chip, this chip is located on board, which is well protected by a hardcover.