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

Lecture – 06
Components of Structural Health Monitoring - Part 2

74. Let us see what are the common tools, which can be used for removing the anomalies in aircraft design or a vision industry based upon health monitoring.

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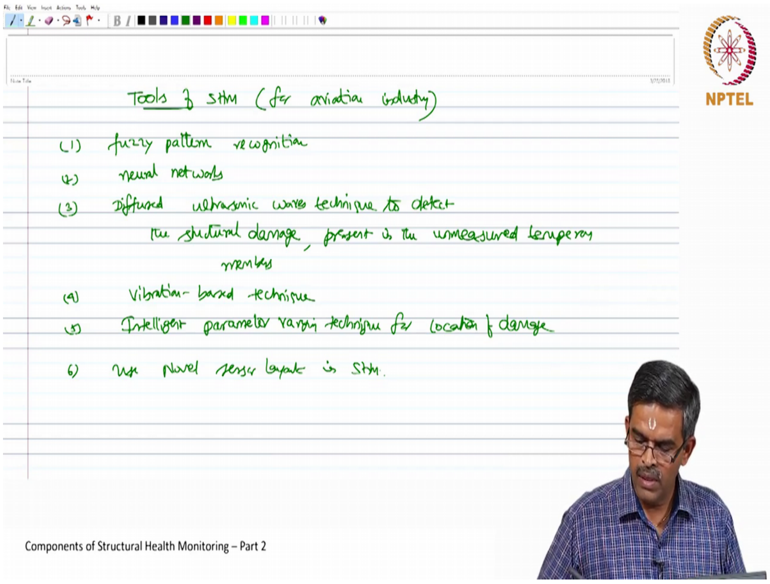

One can use fuzzy pattern recognition, one can also use neural networks, one can use diffused ultrasonic waves technique to detect the structural damage present in the unmeasured temporary members. One can also use vibration-based technique for SHM of aviation. One can use intelligent parameter varying technique for location of damage. One can use a novel sensor layout in SHM.

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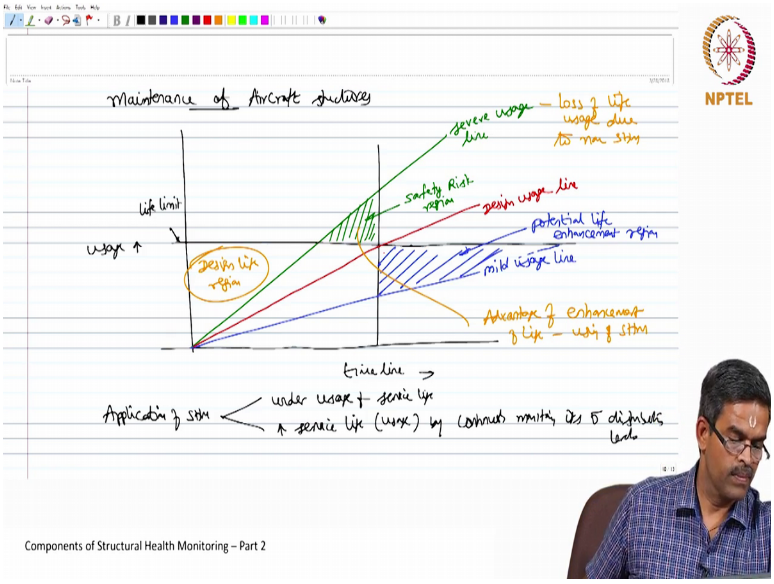

Interestingly friends, if you look at the maintenance of aircraft structures, one can see then the use of health monitoring playing a very major role in successful maintenance of them. Look at this curve which discusses parameters which are contributing to the maintenance of aircrafts. Let us say the time line is on the x axis and usage in on the y axis.

Let us say there is a severe usage pattern compared with design usage pattern, which is further compared with mild usage pattern. Somewhere down the line if you look at the time scale and if you look at the life limit, then this portion clearly shows safety risk region. This line should pass through then this region clearly shows potential life enhancement region. This area shows the design life region.

So, this curve shows that severe usage represents loss of life usage due to non SH, which represents this area whereas, the green region clearly shows the advantage of enhancement of life due to usage of SHM. So, application of SHM can help in checking the under usage of service life of an aircraft, and it can enhance the service life or usage value of an aircraft by continuously monitoring it is stress distribution levels. In this context people also recommend passive SHM and active SHM.

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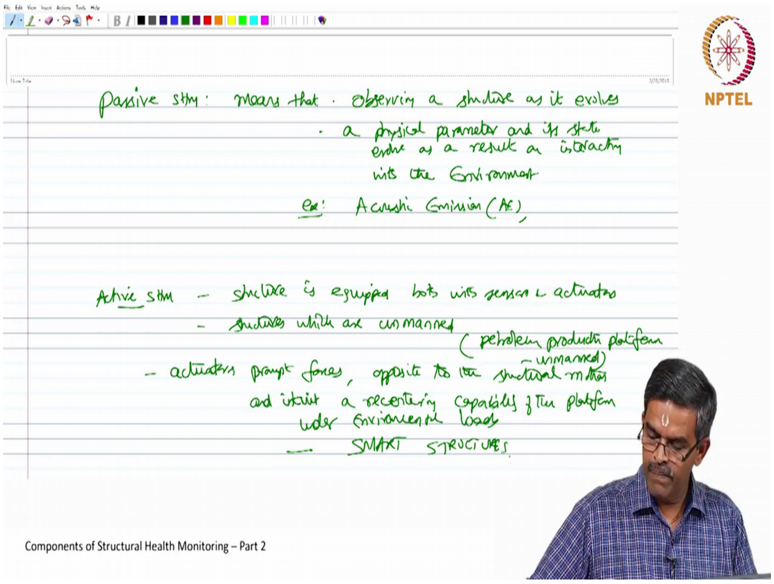

Let us quickly see what is a passive SHM; it means that observing a structure as it evolves. Basically, a physical parameter and it is state of evolvement as a result of interacting with the environment, tools use could be acoustic emission. Active SHM deals with a system where the structure is equipped both with sensors and actuators. This is very highly suitable for structures which are unmanned.

There are many petroleum production platforms in offshore gulf which are unmanned. In such cases, the actuators prompt forces opposite to the structural motion and intuit a re-entering capability of the platform or the system under environmental loads. What we call other ways as smart structures. There are many examples of aircrafts which are embedded with structural health monitoring systems.

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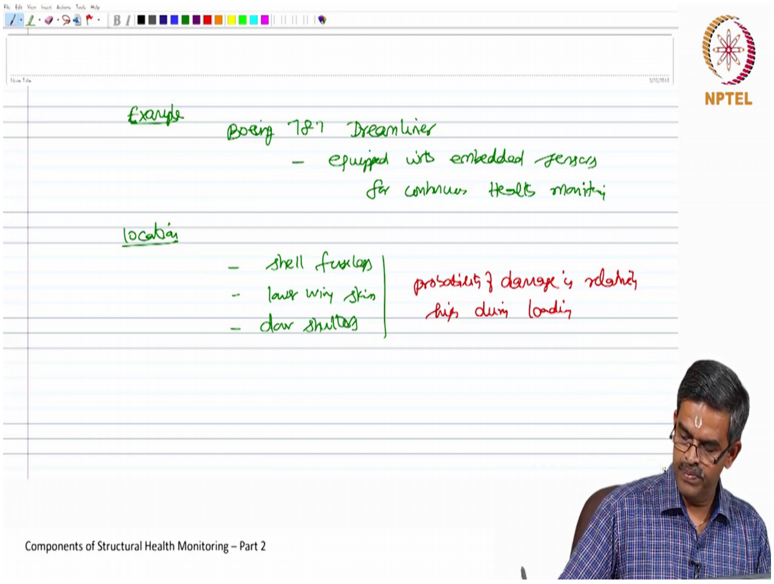

One of the famous example is a very common practice in aircraft industry is that Boeing 787. Dreamliner is an aircraft which is equipped with embedded sensors for continuous health monitoring. Location of the sensors are very important, generally they are located in shell fuselegs, lower wing skin and door shutters. These are the common locations where these sensors are a kept; because these are the places where the probability of damage is relatively high during loading.

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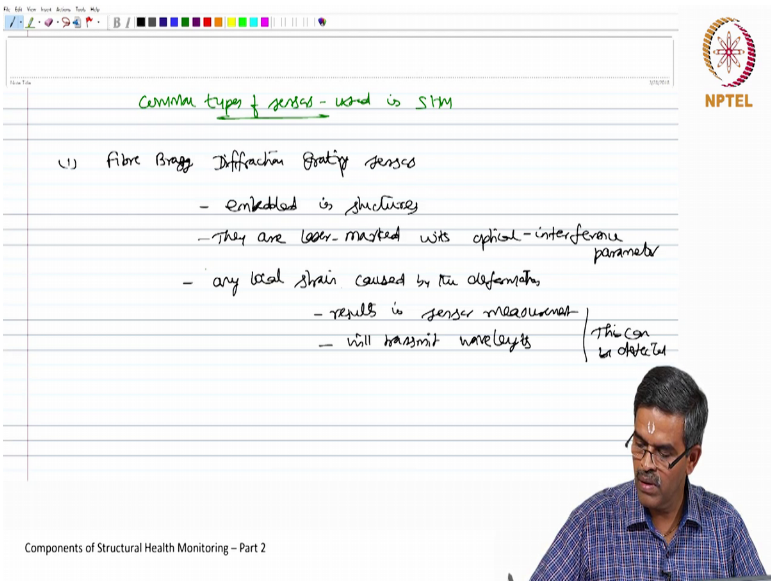

Let us now look into common types of sensors, which are used in health monitoring. The foremost in the list is Fibre Bragg diffraction grating sensors. They are actually embedded in structures; they are laser marked with optical interference parameter. They measure any local strain caused by the deformation, which results in sensor measurement. This will transmit a different wavelength based on which this can be detected.

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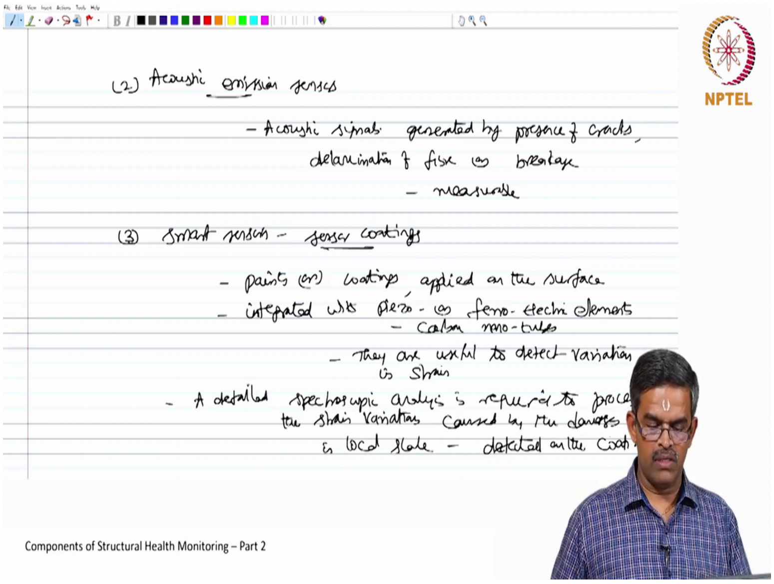

The second type of sensor is acoustic emission sensor. In this type of sensors acoustic signals which are generated by presence of cracks or local faults, delamination of fibres or even breakage, they are measurable. One can also use smart sensors, which are otherwise nothing but sensor coatings. There are paints or coatings which are applied on the surface; they remain integrated with the piezo or ferroelectric elements. Sometimes even carbon nano tubes also being used to detect variation in strain. So, a detailed spectroscopic analysis is required to process, the strain variation caused by the damages in local scale. They will be the damages detected on the coatings, which actually indicate the strain variations.

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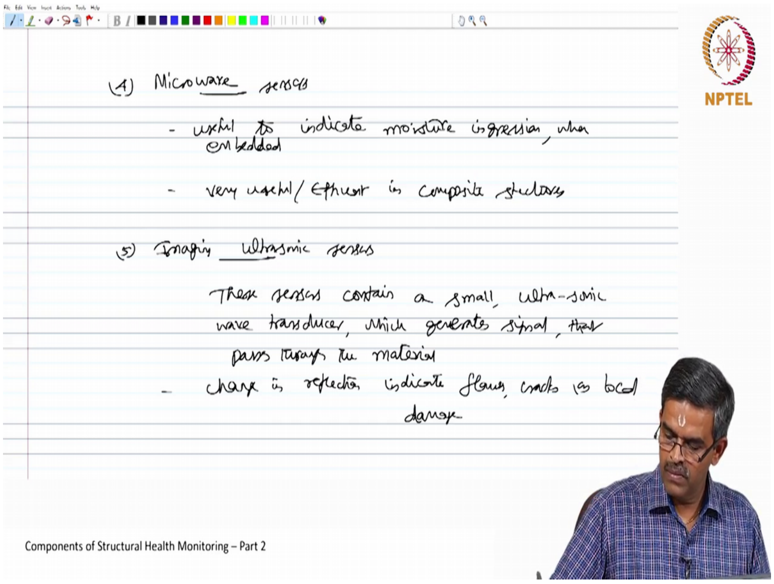

One can also use microwave sensors, they are actually useful to indicate moisture ingression, when embedded in structures. They are very useful an efficient in composite structures. One can also use imaging ultrasonic sensors; these sensors contain a small ultrasonic wave transducer, which generates signal that passes through the material. So, change in reflection actually indicate the flaws presence of cracks or any other local damage. So, friends in this lecture we discussed about various components of structural health monitoring processes.

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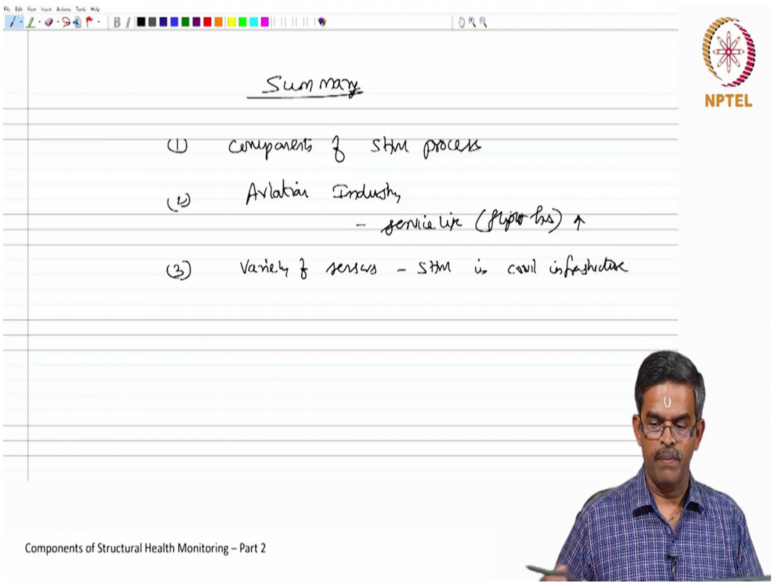

We started looking into application of SHM in aviation industry. We understood that how the service life of an aircraft can be enhanced, what we say as flight hours can be enhanced by continuously monitoring the strain variations on the skin membrane of the aircraft. We have been also identifying a variety of sensors that are commonly used for SHM in civil infrastructure.

Thank you very much and bye.