Structural Reliability
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Lecture –167
Capacity Demand Component Reliability (Part 15)

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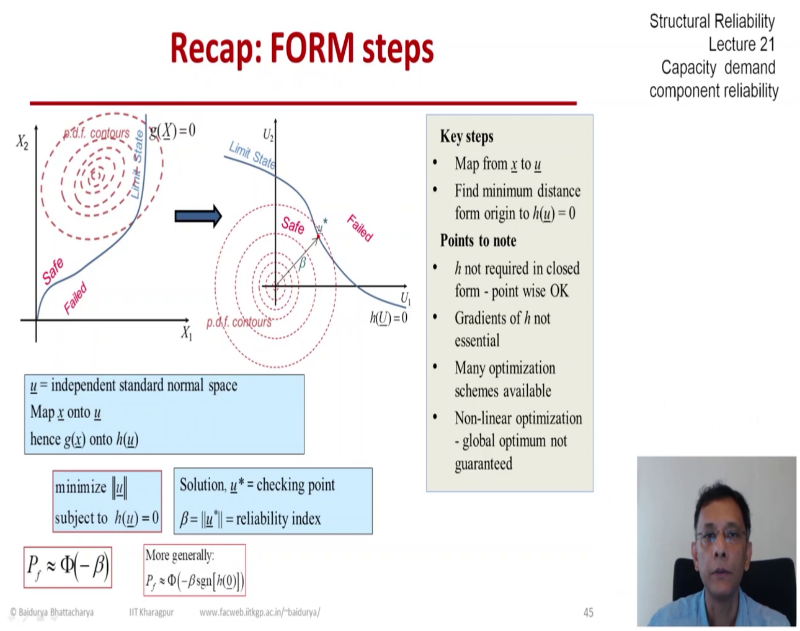

In the previous lecture we described the detailed steps of FORM and what sort of output we might get from a first order reliability analysis of an element. So, let us recap the steps, first we map x the space of basic variables onto u the space of independent standard normal variables. And hence we map the limit state function g from x to u and obtain the new limit state function h and then we find the minimum distance to the line h equals 0 from the origin and that point is called the checking point the optimal point.

The distance is called beta very commonly and it is also known as a reliability index and the failure probability of the element in question is approximately equal to phi of minus beta where phi is the normal cdf. We discussed why we have to include the signum function for to be more complete uh. So, pictorially speaking this is what happens on the left you see the space of basic variables x 1 and x 2.

And the joint density function of x 1 and x 2 is indicated by those pdf contours you also see in blue the limit state line which is a hyper-surface in n dimensions and clearly you see the safe and failed domains demarcated by the limit state. And when we map from x to u we get a new limit state which is h and the pdf contours are now concentric circles around the origin because it is the independent standard normal space.

And there we find the minimum distance and the minimum distance point which is u star as you see and the distance is beta. So, obviously the map we spent a good amount of time discussing the kind of maps we could use from going for going from x to u we discussed we mentioned the second moment transformation also known as the Haseful-Lind transform we discussed the full distribution transform. We discussed the native transform we discussed the Rackwitz-Fiessler transform and the full distribution and the Rosenblatt transform.

So, now to summarize the key steps is that map as I mentioned and then to find the minimum distance now points to note is that h is not required to be in closed form so we do not need really a function but if we have a way to estimate it point-wise that would be quite good gradients are not essential although the methods that we described are based on gradient projection methods.

So, gradients are very useful to have if possible if not available analytically it can be estimated numerically but that slows down the computation there are many optimization schemes other than gradient based methods but one point to note which can be significant is that after all this is a non-linear optimization problem. So, the global op the global optimum is not guaranteed. So, we have to keep that in mind with that in mind now let us solve a set of problems in with form and with increasing level of complexity.