Introduction of Research
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Lecture - 36
Research in Engineering Design

Prof. Prathap Haridoss: Good morning and welcome. It's our pleasure today to have with us Dr. Srikanth Vedantam. He is Professor in the Department of Engineering Design and he is also the Head of the department of the Engineering Design, here at IIT, Madras. He has a B. Tech in Mechanical Engineering from IIT, Madras and PhD from MIT in the United States and he has a lot of industry experience. He has worked with GE Global Research Center in New York and his areas of research include Microstructure evolution, Microfluidics and Wetting of surfaces by Sessile Drops. So, these are you know specific research areas and as he has mentioned his experience in the industry and he has been here as a researcher, as a faculty and as a guide for several years now. So, he has a lot of experience in dealing with research issues, dealing with students, working with students and guiding them through their PhD process. Okay so, with these words of introduction and I am very happy to have you here.

Prof. Srikanth Vedantam: Thank you so much.

Prof. Prathap Haridoss: And, we will go on with this discussion. So, Srikanth, in your department, what would you classify as a traditional areas of research?

Prof. Srikanth Vedantam: Yeah, first with the bio. I have to tell you that our department is little unique. We are a department of engineering design, which there are not many of such departments in the country. So, strictly speaking we don't have really a traditional role as such.

Prof. Prathap Haridoss: Traditional .. Ok. Ok

Prof. Srikanth Vedantam: There are other engineering design department not really department but, definitely focused areas in other countries, in different parts of the world and traditionally, to just answer your question, traditionally there the focus has been on the Design process. So, what we have seen is most traditional departments of Mechanical engineering, Electricals, Civil and so on. At least, in the under graduate curriculum the emphasis is on analysis.

So, somebody has already done the design. The students who come out of the departments are able to do the analysis very well but, the design aspect is not emphasized as much. I mean there are certain definitely certain a like a time, there are times when the people do focus on that, but it is definitely not a majored focus. So, in our department we are being trying to focus on the design aspects. So, to make along like an answer short, in our department the traditional areas have been focused on like materials and then controls aspects for automotive and biomedical educate.

Prof. Prathap Haridoss: Ok ok ok . So, even within this frame work or may be even outside of this frame work are there areas that are more recent and considered you know the modern areas to work in or maybe the cutting edge areas to work in this field?

Prof. Srikanth Vedantam: Yeah, and the answer to this is probably actually, can have a wide ranging answer in the sense that, in order to be in the forefront in our department research areas. You have to be able to cut across disciplines. So, no longer are you if you are a traditional mechanics or a traditional will you able to bring their all everything to bare, to bring better designs forward. So, the ability to be able to transition at least in terms of being able to understand the language of, if you are a mechanical engineer understand the language of electrical engineer and what their constraints are and conversely, if you are an electrical to understand what a mechanical constraints are. The ability to do that is what is the next you know front here in?

Prof. Prathap Haridoss: Ok.

Prof. Srikanth Vedantam: and I think it's true for many other departments as well.

(3.54) Prof. Prathap Haridoss. Ok Ok .So, in your department as you mentioned, you have this multidisciplinary approach. What sort of issues do you know do incoming MS, PhD students face? Let's say, the early part of their you know stay here, what sort of issue do they face you know? And what are typical approaches you would have for handling them that you can expect?

Prof. Srikanth Vedantam: Right. So, the main thing that you know based on the fact that I just mentioned that interdisciplinary and multidisciplinary kind of approach is very important. The one of the main issues is the fact that traditional preparation of incoming graduate students is usually strong in one area. So, the way we try to address this is to have them do courses across many disciplines. So, the first initial portion is spent in some amount of course work, which we believe actually it no, it adds value over the life time anyway. So, some of this is being addressed through this wide ranging course work, where people are not sticking to just one area and trying to focus their efforts in very narrow specialties.

Prof. Prathap Haridoss: Okay from, see when we talk of research, we tend to think of an academic setting and you know students are here in an academic setting and within that and research tends to be a specialization in a particular problem, which has a lot of scientific input to it and so on. In this context at least with respect to your department, where do you see the industry interest? Because, industry typically may have a you know more immediate term focus, they may not necessarily. They may be interested in long term projects but, typically they are focus and thrust is on the immediate future. So, where do you see the you know overlap? Where does industry show interest in activities that you pursue?

Prof. Srikanth Vedantam: Right, it's a good question because, so, in our department we actually are expected, there is a natural acceptation that we would interact much more closely with the industry and try to address problems right from the industry perspective. But, that said, at the end of the day in an academivc environment what we view is that, we want people to try to understand the science aspects. Fine because, the really the large jumps that can be made in terms of technology and development can be understood only by the application of the science as if it's well understood.

Otherwise, if we look at it purely from industry development perspective, you can the kind of approaches that even make are only like a sort of small tweaks that will help improve things that will be at a short term. So, in that sense industry does look to our department to try to provide the scientific basis by which you can try to you know have industrial relevant problems but, with the little bit more long term perspective. And, I think that is true, while is true for our department in particular, I think all of I mean all academic departments should be in that mode. Where they are trying to, at least in engineering departments definitely, should be trying to focus on application of science to problems that are just a little bit longer than what the industry perspective is.

Prof. Prathap Haridoss: Yeah you had also mentioned like automotive industry and where I know biomedical industry, from their perspective are there specific you know kinds of projects that they are looking at an academic environment to show the leadership to help them solve?

Prof. Srikanth Vedantam: Yeah.

Prof. Prathap Haridoss: You see.

Prof. Srikanth Vedantam: So, some of our colleagues are you know like an actively participating with the automotive industry in terms of you know new tire designs, handling of vehicles, in terms of the stability, noise vibration aspects and so on. So, when the industry is participating, working on those aspects or problems usually, as I mentioned the approaches they take are only leading to small tweaks which will give incremental advances. So, what they are looking for in our colleagues and the research areas which our students are engaged in, is they can see if they can completely disturb the technology, they can come to probably new.

Prof. Prathap Haridoss: Very nice, yeah, yeah.

Prof. Srikanth Vedantam: So, by application of fundamental science.

Prof. Prathap Haridoss: Ok.

Prof. Srikanth Vedantam: So, in the sense that even though we are a technology oriented department, the science aspects are still important and we focus on them but the application to coming to like the next level, next generation of products.

Prof. Prathap Haridoss: Okay so, the science the basic understanding pushes the boundary much more significantly than you know locally tweaking it.

Prof. Srikanth Vedantam: Exactly, that's the point I want to emphasis really for.

Prof. Prathap Haridoss: That's I think a very valuable insight into the process. So, when, see students come in for Post Graduate degree, a Masters degree and PhD degree they come in with some variety of different back grounds, different colleges and institutions from which they come in and then they go through this process. So, if we look at that process of you know 4 5 years that they are here and then may be even their early carrier. In what ways should they, in what ways do you measure success in their research activity? In what way should they themselves be measuring their success as a researcher?

Prof. Srikanth Vedantam: So, this is a good question because it's not a like a very easy question to answer. There are various measures of success, but at end of the day at least from an academic view point, what I try to you know advice incoming students is that, they should always focus on the process of trying to solve a problem, not necessarily the specific problem itself.

Prof. Prathap Haridoss: Ok.

Prof. Srikanth Vedantam: So, in other words we want people to understand the process by which you are able to take relatively, like you know vaguely stated problem, because not many problems will be stated in a very precise fashion either by the customer in an industry or even like in our research problem in it's initial stages. So, how do you take that vaguely stated problem make it more specific, make very specific assumptions for

that problem, try to develop the tools or use appropriate tools to solve it and then defend what you have, the assumptions you have made and the results conclusions you are drawing in a coherent fashion.

So, this is the process of research which I think spans all like in a discipline and I do emphasize our students and all graduate students that I meet, that they should think about this overall process which they are learning. So, in other words, tomorrow if they are trained right now in one particular application of this process. So, somebody is doing some advance designs in automotives but their understanding the process by which they are going through. Tomorrow, if they have to do it in a slightly different discipline they will be able to carry over this process, the way which they specify make the problem more specific, that how they like obtained the tools to solve them and then how they defend the conclusions they make. So, as a graduate student and academic this is how I measure the success of a graduate student.

Prof. Prathap Haridoss: Ok.

Prof. Srikanth Vedantam: In terms of whether they have learned the process.

Prof. Prathap Haridoss: Learned the process, Okay great.

Prof. Srikanth Vedantam: So.

Prof. Prathap Haridoss: See, when we look at Masters Students and PhD students when they get their degree, I mean the general perception and to some degree it is true. Is that you know they are now specialists, specialist in not just engineering design but they are specialist in particular topic in engineering design and have looked at the topic in great detail and so on. So, when that is the case, what sort of you know what impact does it have you know in terms of their professional growth? Later on, in the sense that, what sort of positions do you normally see students in engineering design, graduating students in engineering design? What sort of positions do they tend to take up once they graduate?

Prof. Srikanth Vedantam: So, so far our department is relatively young. So, we have had a like you know smaller number of people going out after their graduation here, but so far the emphasis has been predominantly into the industry.

Prof. Prathap Haridoss: Ok.

Prof. Srikanth Vedantam: So, we had people of gone into the like research labs of biomedical companies as well as in the automotive R and D sector. So, and but but I see there is a trend where people are trying to go into the academic side as well and have, we are several students who are right now very focusely pursuing their academic carrier as well. So, right now the as assure a story I mean question in a more focus fashion it's mostly industrial.

Prof. Prathap Haridoss: Okay, that's very nice to know I mean I think people tend to think that it is once you do research you have to do, you probably moving away from industry but I guess not. You are saying that in fact, in your discipline lot more people goes I mean the industry interacts much very well with the students graduating from your department. So, a little while earlier you spoke about the process, the process by which a person becomes a researcher and so on. So, to what degree and how much does the interaction between the guide and the student contribute to this process? And, in that context in a more mundane sense, how often do you think students should be meeting their research adviser in during their research process and career?

Prof. Srikanth Vedantam: So, for this my own view in the beginning stages of a research like, I know graduate student trying to start their research program, it should be a lot more frequent kind of meeting may be even once in a week or even at a little smaller time frames. The reason I say that is that, the process of identifying or making a vague statement of our research problem into something more specific that is more tractable is actually one of the more difficult parts of the research methodology.

Prof. Prathap Haridoss: Ok.

Prof. Srikanth Vedantam: So, considering that you have put in the most difficult aspects in the beginning.

Prof. Prathap Haridoss: Beginning.

Prof. Srikanth Vedantam: I think that's where the interaction should be really like you know, more frequent.

Prof. Prathap Haridoss: More regular.

Prof. Srikanth Vedantam: So, then after that there will be a stage where it's just learning tools, and implementing them. That part to the students, researcher could discontinue to do it on their own because first of all the other point of time even the meetings get less frequent may be even a month, once a month. It's better that way because there is no spoon feeding of tools.

Prof. Prathap Haridoss: Ok.

Prof. Srikanth Vedantam: Tools is something that we have to be able to pick up at the end of our research training. We should be able to learn how to read an under graduate text book or even a math's level text book to learn the appropriate tools to solve a problem, that part we have to get that independence. So, the initial part where you are still focusing down the problem may be lot more interactive.

Prof. Prathap Haridoss: Ok, and then.

Prof. Srikanth Vedantam: Once it goes along, then I think it can be as needed like you know how the tools are.

Prof. Prathap Haridoss: Okay great. So, now to sort of wind up and finish this now, close this discussion. What is your advice to students who are aspiring to be you know researchers in the field of engineering design?

Prof. Srikanth Vedantam. So, I would advise them, first of all to try to have much inter disciplinary interests which will make them first of all like much more useful to the eventually industry that they go to or if they go to an academic environment they will still be having like, like they may be bring much more to the table if they do that.

So, first advise is to be much more interdisciplinary and being able to try to like you know, show interest as well as like you know curiosity in subjects that are not immediately related to yours specialized area. Then, other thing is that I think try to have a big picture of what you are trying to solve. In other words, lots of times has when we have focus on our research problem we tend to look at every minute aspects of the problem as they are looking at. But, all the time if you are able to keep a big picture of where this problem is going to fit and how it's not usual that we solve like a really societal need, start to finish but, but each of us will contribute to a small part of it.

Prof. Prathap Haridoss: Small part of it.

Prof. Srikanth Vedantam: That is what we usually have time for and we are able to focus on, but if we understand were this solution that we are providing fix into overall picture of our societal need, that helps us really contribute much more than if you are just focusing on your minor problem.

Prof. Prathap Haridoss: Ok.

Prof. Srikanth Vedantam: Minor problem, that is all.

Prof. Prathap Haridoss: Thank you Srikanth, for joining us. We are really glad that you could join us and share your experiences with us. Thank you for coming.

Prof. Srikanth Vedantam: Thank you.

Prof. Prathap Haridoss: Bye.