VLSI Design,
Verification & Test

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Introduction no.1

Welcome to the introduction lecture of the course VLSI design verification and test. So today is the introduction for the first lecture.

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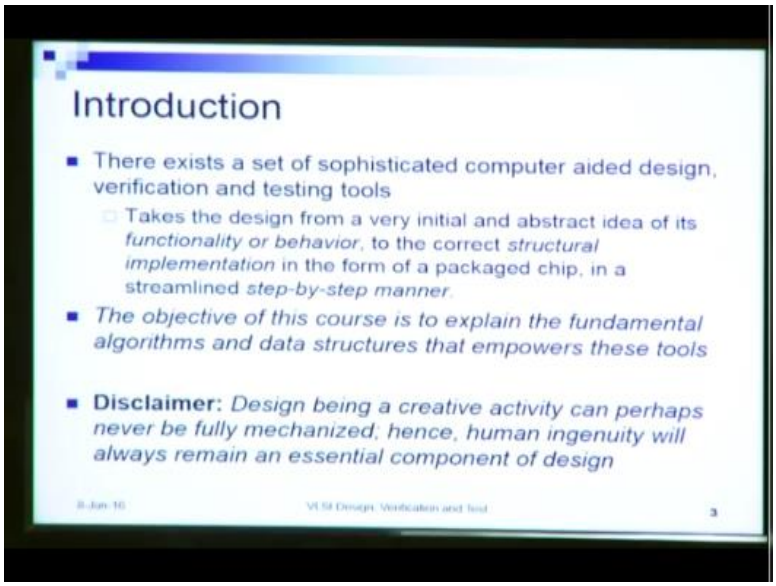

So as we said VLSI design today is conducted through the set of very sophisticated computer aided design verification and testing tools. These tools take the design from ma very initial and abstract idea of the functionality or behavior that we have in on mind. This can be an initial idea, lot formalized and lazy one.

And then we first formally specify this idea in the form of a sake of photograph or in a hardware description language. And then probably take it down to a completely structural implementation in the form of a packaged chip. This is done through a very streamlined step-by-step manner. So the design process as evolved for years of results and it has today become almost a science.

So the objective of this course is to explain the fundamental algorithms and data structures that empowers these tools. So just to see more at the beginning of the course, that design being a creative activity can perhaps never be mechanized means you cannot explain that you will have a push button and from the initial design and you will get the final packaged chip.

Human ingenuity will of course be required at each of the design to understand how the different aspects of the design can be optimized to get what we want to achieve through the design.

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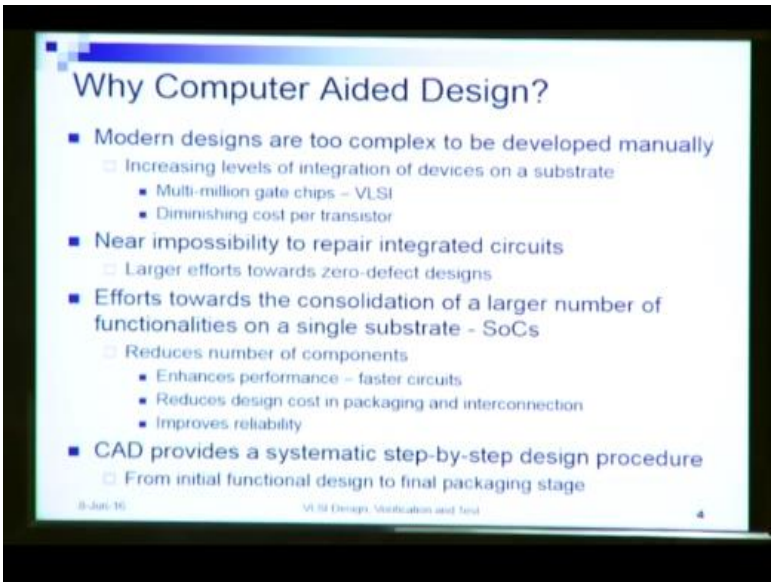

So why computer aided design? So if you are talking that today VLSI design verification and test is done through computer aided so why computer aided design the first answer is model designs at complex to be developed manually in the 1960's we had integrated a few 100 may be device components so on a subscript on a venues I chip and we have come today where there are multimedia gates for chip on for a subscript and with that we diminishing cost of transistor port transistor cost as diminished drastically over the years is therefore on one side because the number of transistors further as increased.

We have been able to integrate more and more functionalities into the same design into on to the same subscript and hence the design as gone from simple to very, very complex and this almost impossible to be done only or fully by hand on the other hand this diminishing cost per chip per transistor as made it possible to device harder circuits to make harder circuits for possibly everything so today we have variable devices embedded device to iron these and all these are in essence embedded system which are integrated into a chip.

So therefore the desires the desires salary and the time to market has become very important here right so save such designer salaries time to market we need automated system automated algorithms which will take the design from the initial inception to the final package defense CAD the same important reason is that VLSI are kits are almost impossible to be impact after the design after which is design an just a hardware like so it cannot be repaired afterwards so therefore there is a need to design almost 0 defect designs we need to create almost 0 defect designs and hence it has to be done for automatic tools because human are pamphlets there has been a larger and larger effects.

The third important features is that we are trying to concentrating today many functionary it is on a single chip and we are professedly moving towards what is called system chip so that everything will be integrated into one chip why is this happening, because it reduce a number of components or it reduces the number of components so that number of different chip that you require it enhances performance faster chips because inter connection between chips.

Or inter chip inter communication will be always slower than intra chip communication, this also reduces design cost in packaging a inter connection because you are not managing many things into a single chip and it also improves reliability because now always inter connections introduce errors in between, if you see today this if you see as an example this plane towards SOC's we can take the example of a mobile phone say today's mobile phones have processes within them.

Obviously a mobile phone will require processor and we most probably read your reduce instruction say architecture risk processor but along with that it means specialized DSP's digital signal processor for say voice and image data and special instructions in catering to signal

processing other different ISO signal processing it will have RF circuits radio frequencies or tips the mobile device should be able to communicate to the outside worlds so it will require RF circuits it will require analog components so communication is basically an analog aspects so therefore it will require analog components digital to analog converters analog to digital converters all within the same chipper.

It may require custom digital units for example, if you need to do high performance encryption decryption of image data you may need to design an asic within the chip, so asic meaning applications specific integrated circuits, so we should understand there is a certain difference of this asic's with asip's which are applications specific instructions and processors the certain difference being that although acis can have controllers within it, it will not include programmability.

Programmability will be an aspect of asip's and not asic, okay so it can also have menses or micro electronic sensors because it will have different types of sensors pressure sensors, temperature sensors, proximity sensors extra, so therefore we see today that in our mobile phones to the same chip includes a lot of functionality together and with maybe regarded as a system on chip, I said system on chip there is a profession of the system on chips today, and hence many functionalities are being included such designs are very complex and we need computer to design for that.

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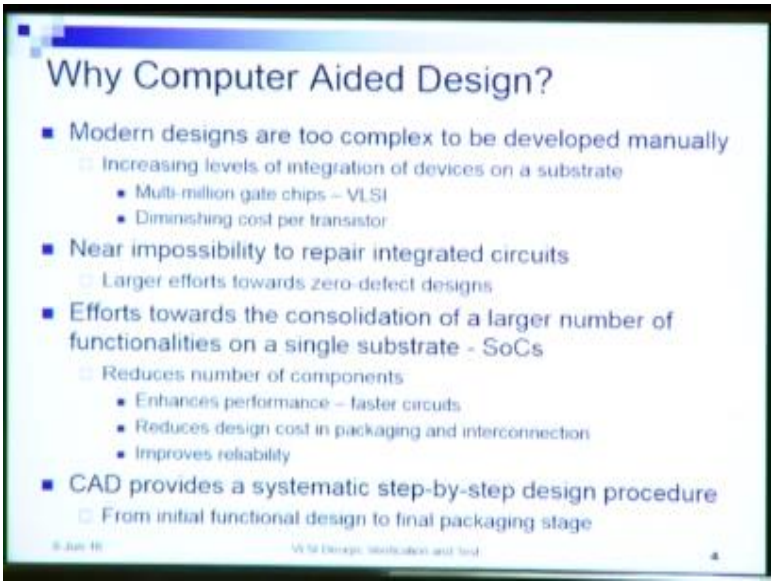

Also CAD provides a systematic step by step design procedure as we said so it will take the design from one step to the next until the final chip is from final chip is produce, and the hence the necessity of CAD also higher integration as we said many transistors with in achieve higher integration will lead to huge power dissipation because all this transistors within the chip each of them will lead power and hence there will be huge leakage power and correspondingly we will have hot sprats generator with the chip.

And the heat today to can be close to the hear that is generated with today's frequency at which at this chip operate and with the number of components in the chip it could be that almost compare to a rocket loser and hence people have device to ways design mentalogies by which the designs will be aware of the power consume and those hot sprats and the design will be optimized accordingly.

So there is focus towards low power design strategy is at each stage of the design there is an increasing trend towards all tolerant design is well so today we have safety critical empery devices.

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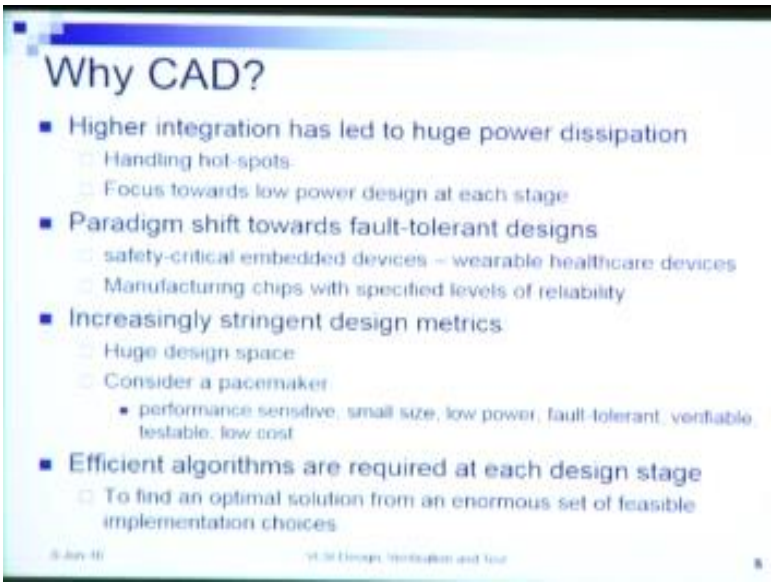

For example wherever health the health can device and manufacturing this chips with very specify levels of reliability is extremely essential for example if we take the example of space maker see today it must be it must say it must be able to response to very quickly with respect to say a missing heart beat so therefore performance is extremely essential it the design of this pace maker with that this pace maker will be place where inside the heart.

So therefore it has to be small in area so we understand that when we try to increase performance we need to parallely need to do many things and doing things parallely means we need higher area of doing them however a pace maker cannot consume a lot of areas width it has to be low in area because it has to be placed within the heart it has to consume low power but the reason is that it has to run for years together within the heart so therefore it cannot consume a lot of power.

So therefore it has to be power efficient it has to efficiently utilize the batteries power it has to be fault tolerant obviously it cannot, it cannot be suffered upon being placed within the heart so therefore it has to be highly reliable and hence high reliability also means that this chip needs to be easily verifiable easily testable and most importantly last but not the least it must be low in

cost so that it becomes affordable to the community so what we trying to say that today's devices will require a whole lot of design optimization to achieve at the final product.

And for such complex designs compute rated designs is extremely essential and so what we understand is that therefore we understand that at each stage of design we have different alternate of the design right we can be very efficient on area we can lack on performance all these things and it gives us a very big design space which means that there are many possible solutions within the given total space within the which the solution can lie.

And finding optimal solution from this enormous set of feasible choices almost always will require computerized design cannot be done by man hence computerized design thus with the basic understanding computerized design required we come to end of the module one of this lecture.