Indian Institute of Science

Design of Photovoltaic Systems

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NPTEL Online Certification Course

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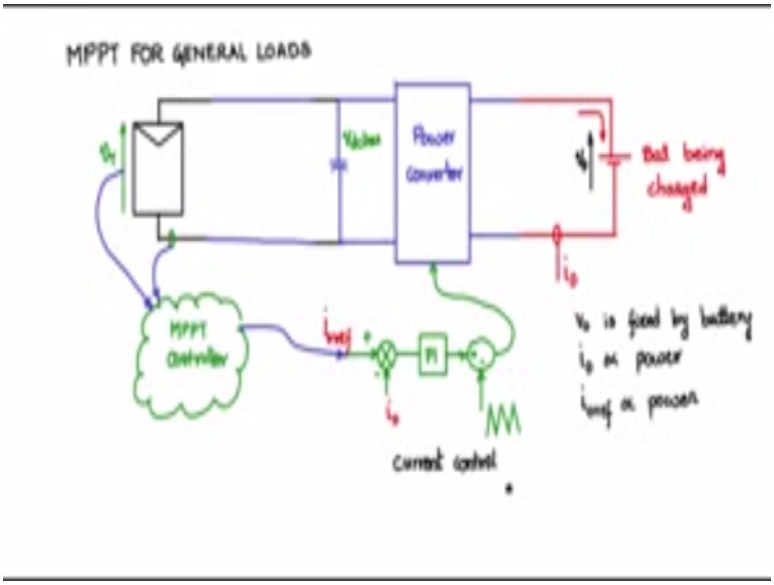

Another practical point, that I want to mention is that we have studying MPPT, where the load resistance or not, but many times the load need not to be resistance it could be dynamic it could be comprising of other capacity loads, other DC-DC convertor loads, and similar such dynamic elements. So how do we perform MPPT, so if we take our normal MPPT topology it is something like this?

Where you have DC-DC convertor, which is interfacing the PV source and I have a MPPT controller which takes the PV current and the terminal voltage, and then, provides the duty cycle inputs to the DC-DC convertor such that the seen from the across the terminal of the PV panel is controlled. Now this load R0 is conductor resistive, now let us make this into a dynamic load and see what happens.

So if I consider this load and remove this replace the load with dynamic this load with the dynamic load consisting of let us say capacitance, now this becomes a DC bus, and that capacitance is connected to another power convertor, it could be a switched mode DC-DC convertor or an inverter. So I will just name it as a power convertor which could be DC-DC or DC-AC, and goes to a load.

So this load is a indicative load which could be resistance, it could be heater, it could be any general load or a lighting load. So any general passive load here, so what is generally done is that, the voltage here the output voltage V0 is controlled, because the load demands a controlled fixed specified voltage. So generally what is done is that, you have a comparator, and the comparator takes feedback V0 is given as feed back here, V0 and there is a v not reference, you want your V0 to take a value as said by the reference.

And then this comparator output given to controller lets a PI controller, output of the PI controller goes to a PWM circuit and output of the PWM goes as duty cycle input to the control input to this power convertors, such that the duty cycle is change such that this V0 will match V0 in the steady state. So this is in general how this power controller will behave. And as for this power convertor is concerned it has a DC bus here.

And that the DC bus is varying, now this VT across the PV panel, and the DC bus here both are varying VT varies due to insulation, and not only that but due to this duty cycle control VT value also varies, because of the IV characteristic which is, which gives different values of VT and different operating points. So as you are controlling the input power or the impotency at the input site, the voltage across the f this DC-DC convertor, is uncontrolled.

So this will fluctuate, this will vary depending upon different values of D. In order to regulate the DC you put one more power convertor here and give the input varying nonfiction DC bus voltage to this power convertor, and then sensed output voltage here, feedback and then control this output voltage. So this becomes a voltage controlled power convertor, which will regulate the output voltage that is given to load to the requirement.

So this general way in which the MPPT is practiced. The first part, the first converter which is interfacing with the PV source is the MPPT part. The second part is the load part or the voltage regulating part for the load. However, the power is to flow through to power convertors and

efficiency is if this is 90% 90 and 90 totally overall 80% efficiency. So the efficiency will be lower than the if we operated with the single power convertor.

Let us now consider the load such that this load is like a battery, like a source which is capable of sinking, in the battery charging or pumping power into the grid. So let me replace this load by a battery, and the battery is being charged. And therefore, it demands a sinking current like this, so that it gets charged up. So as a consequence the battery current will become I0 and this is what as to be controlled.

So the power converter will behave in such a manner that it will control the current that that is being fed into the battery to charge it up. So I0 has to fed back, so I will change this portion, I0 is fed back and I will have an I0 reference. So I0 and I0 reference, are compare the error is driving the PI controller, the output of which will modulate this triangle carrier and you get the modulated control input to this power convertor which will operate in a manner such that I0 will try to match I0 ref.

Now as the V0 voltage across the battery is fixed, the voltage across the battery is more or less constant fixed by the battery, because the battery is also a source. The current that is being pumped in, the current into the V0 is the power and as V0 is fixed current is representative of the power, and we can say I0 is proportional to power, being fed into the battery. And as I0 matches I0 ref it will ultimately try to reach the I0 not ref, I0 ref is proportional to the power that is being fed into the battery source.

So to charge it up, so I0 ref being proportional to power, and there is this MPPT controller which is measuring V and I or the PV panel and trying to give a output here which is proportional to maximum power, that the PV can deliver, we can connect this to this reference. So let the reference I0 reference be set by MPPT controller such that maximum power can be deliver to the battery for charging.

So what we will do for this current controller, we will give the reference to the MPPT controller. So the MPPT is finding out which the peak power operating point accordingly the current reference is being set, and I0 here will try to match it, and maximum power will deliver to the battery for charging. Under such condition, this portion is now not needed. So we can remove that portion make this connection and we see that, we just need MPPT controller portion.

And we need the current controller part, and then we need this power convertor, power is flowing through the only one power convertor. And therefore, efficiency is greatly improved. So wherever there is a load like the battery, wherever there is a source type of load which is sinking to the charger or the grid where we can sink power, you can use current controlled technique and MPPT can directly feed into the reference of the current controller.

In this way you will be improving the efficiency and get the better utilization of the PV power. The same method can be applied even to AC voltage sources for example, the grid and similar type of topology can be used.