Abstract

The fast development of large capacity Gate Turn Off thyristors (GTOs) has made possible to manufacture self-commutated converters employing GTOs for power applications. The ASVG is one kind of these applications. It is a novel reactive power compensation source. Nowadays , the most practical ASVG systems employ PID controllers to control ASVGs because it is easy to implement . However, the dynamic response of ASVG will be poor if it is controlled by PID controller . In order to design a better controller , it is necessary to derive the mathematical model of ASVG system.

In this thesis , the mathematical model of ASVG system is derived at chapter 2. From this chapter , we know that the ASVG system can be described as a set of three non-linear differential equations . Two of them are the basic swing equations of the generator in which the generator is represented as second order model . The third one is obtained by applying the energy conservation , i.e. the charging power of the capacitor should equal the input power of ASVG . One special point in this derivation is that the loss of ASVG is not neglected because the resistance can influence the precision. Once the mathematical model is obtained , different control methods can be applied to build up a high quality controller and the linear optimal control theory is used in this thesis . The control law will be obtained by applying linear optimal control theory in chapter 3. Since this control law is obtained at a certain operating point , one may ask " Can this control law stabilize the system due to large disturbance ? " . The simulation results show that this control law can stabilize the system very fast due to large disturbance . The validity of the proposed method is demonstrated by simulations in chapter 4. In this chapter , two important facts are shown . The first one is that the output reactive power of capacitor type ASVG is controlled by adjusting only the firing angle and not the conducting angle and points out the mistake done by some authors who use the conducting angle as control variable . The second one is that considering the resistance can increase the precision of the mathematical model . From this chapter we know that if the resistance is neglected , there is large error when the system requires a large amount of reactive power . In order to compare the performance between the PID controller and this linear optimal controller , some simulations are done , which show that the performance of the linear optimal controller is better than that of the PID controller . There are three important parameters in this mathematical model , i.e. the losses of ASVG (R), the capacitance (C) and the transformer leakage (X_3) . They are important because they can change the magnitude of the output reactive power or its property or both of them . For

example , the capacitance can determine the time constant of the charging or discharging circuit so it can also affect the change speed of the capacitor voltage . It means that it can change the instantaneous output reactive power . It is necessary to analyze these parameters . The contributions of these parameters are discussed in chapter 5 .