CHAPTER V

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

In this work, the continuous stirred tank reactor has been studied. The nonlinear adaptive control has been designed and implemented to control the reactor temperature at 54.2 °C by manipulating a jacket temperature. Moreover, the EKF is used to estimate unmeasurable heat released by reaction and incorporated with the controller. The simulation results can be concluded in Table 5.1.

Table 5.1 The IAE comparison of nonlinear adaptive, GMC and conventional PID controller

Conditions	**IAE**		
	Nonlinear adaptive controller	**GMC**	**PID**
Nominal case	387.01	387.01	387.01
Model-mismatch			
+20% U	387.73	388.08	
-20% U	387.76	387.99	
Plant-mismatch			
+20% U	367.99	368.21	368.24
-20% U	416.51	416.79	416.86
+20% ΔH_r	859.21	859.34	876.80
-20% ΔH_r	59.36	59.37	60.01
+20% k	415.45	415.50	415.82
-20% k	346.56	346.60	347.09

Case 1 is the nominal case, in which all model parameter used to simulate are specified correctly. The controller parameters of nonlinear adaptive, GMC and PID controller are tuned to achieve the same values of IAE. Therefore, the control responses are similarly.

In Case 2 is model mismatch case that caused by model of controller. Although, the performance of EKF has deteriorated when compared to that of the nominal case, the nonlinear adaptive control still provided good control performance. The control response of the nonlinear adaptive control as same as GMC, but the nonlinear adaptive control gave smaller IAE than GMC did.

In Case 3 is plant mismatch case that caused by process change such as overall heat transfer, heat of reaction and rate constant. It has been found that the heat released by reaction is sensitive to the heat of reaction. The performance of EKF has deteriorated in some case when compared to that of the nominal case. However, the nonlinear adaptive control is provided reasonably good control action in all cases. The comparison of performance between the nonlinear adaptive control, GMC and PID controller can be found that the nonlinear adaptive control gives performance better than GMC and PID. It can be concluded from this research that the nonlinear adaptive control has been found to be effective and robust in tracking the temperature set point of the continuous stirred tank reactor (CSTR).

The reason why nonlinear adaptive control better than PID is that the controller parameter of nonlinear adaptive controller can adjustable when the process changes. It utilizes the measured reactor temperature, jacket temperature and estimated heat released by reaction. Nevertheless, the conventional PID control utilizes only the errors between the desired set points and the process outputs to generate the magnitude of manipulated variable. In addition, the performance of PID controller depends on the tuning parameters chosen.

5.2 Recommendation

Some recommendations for future work are given below. In this research, the generic model control is used as a controller which the adjustable controller parameter

used in simulation is only K_1. If both controller parameters, i.e. K_1 and K_2, can adjustable it will improve the performance of the controller. In addition, the nonlinear adaptive control strategy will be applied to the highly nonlinear and complex system such as batch distillation process and polymer plants etc.