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Research Paper

Analysis of Rejection of Step Disturbance Using Lqg Synthesis Method with Compensator C to Find Poles and Zeros in case of Niguist Plot Criteria.

Engineering

KEYWORDS : Linear-Quadratic Gaussian, Linear-Quadratic Estimator, Damping Ratio, Un-Damped Natural Frequency.

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ABSTRACT

LQG controller is also fundamental to the optimal perturbation control of non-linear systems .This paper presents a Linear-Quadratic Gaussian method of synthesis with compensator c to find poles and zeros in case of Niguist plot criteria. Here we find dynamic values of poles and zeros for type real pole, integrator and complex and later we determine values of location, damping and frequency to see the effect of poles and zeros on Niguist plot criteria. The value of frequency is maximum in real pole i.e. 42.8 at location -42.8 at damping value 1.The value of poles and zeros for type complex are lowest at location -0.0526 +/- at for frequency 2.74. at damping value 0.0192.

I. INTRODUCTION

The design of a controller for a linear system with input saturations is a challenging task .Interconnection of different parts to give the desired output involved in some control action also is called a control system. There are two types of control system open loop control system and closed loop system. The open loop control system is also called feed forward control system and closed loop control system is also called feedback control system. The loom invented by Joseph Jacquard of France in 1801 is an early example of feed-forward. Compensator is an addition of circuit or any device in the control system to give a desired output .it is generally of three types:

1 Series compensator.
2 Feedback compensator or parallel compensator
3 Lead compensator.

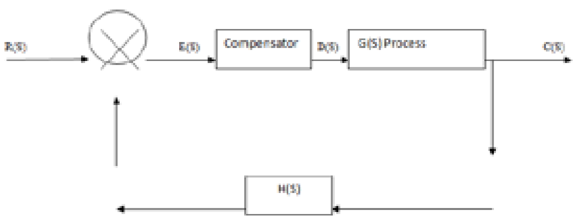


Figure-1 Block diagram of Series compensator

Here in this diagram R(S) Stands for input, H(S) stands for feedback, C(s) stands for output and E(S) stands for error. Where Gdc - The DC gain for G(s), z - The damping ratio for G(s), wn - The undamped natural frequency for G(s),K - The proportional gain in the controller, Desired output, u. Feedfoward control system is more stable as compared to closed loop control system and complexcity of open loop control system is much less than in comparision with feedback control system.

II. LINEAR QUADRATIC GUASSIAN SYNTHESIS METHOD

It is very important method to design a control system. When we synthesis a single input single output (SISO) control system, we have to follow various steps in order to synthesis SISO control system. The LQG is simply the combination of linear-quadratic estimator (LQE) and linear-quadratic regulator (LQR). The solution of this is different that is used to constitutes a linear dynamic feedback control law. You can use optimization-based tuning to create an initial compensator design or to refine the current compensator design LQG control applies to both linear time-invariant systems as well as linear time-varying systems. The purpose of LQG optimal control theory is to give a systematic method to synthesize a control laws for learning performance index so that it will cancel the unwanted disturbances that disturb the system .There is a application that enables the design of linear closed loop controller for viewing non-linear uncertain systems. The LQG controller is dynamic systems that can controls. It is easy to any engineers to use a complete and new design method without losing the critical gain and frequency response. There is one more limitation that while implementation LQG controller can create problem when the dimension are large. Whenever there is reduction in the order then we can overcome this issue by adjusting number of states of controller. Later we find that this is a serious problem because it cannot be seaparated.In order to solve this problem we have to look important and difficult method because it has large number of equations and algorithm part. A large controller bandwidth generally increases the response speed but it may push the system to its limit, leading to oscillations or even instabilityFinally, a word of caution. LQG optimality does not automatically ensure good robustness properties. We have the advantage of checking stability of the system after designing the LQG controller. To know some properties of robustness it is important to know the frequency response of the system. We find one advantage of this LQG method that it provides how the circuit elements influence the frequency response. This thing is very important for the design of frequency-selective circuits.It concerns uncertain linear systems disturbed by additive white Gaussian noise that that have incomplete state information.

III. REJECTION OF STEP DISTURBANCE

By the term step disturbance we come to know that this thing occurs when there is change in the actual performance of the system. We can compensate this problem with the help of control system by providing feedback. Here we used LQG synthesis method to reduce the adverse effects of disturbances by providing automated tunings to analyze the effect of step disturbance. There are large numbers of hydraulic or numeric systems that disturb the matching condition. It is very difficult to reduce the adverse effects of the disturbances by the traditional disturbance observer. Based on the algorithm that we use in this paper estimates and compensates the effects of the unknown dynamics and disturbances. Instead of this algorithm, Disturbance rejection is a standard purpose for the introduction of feedback control; without disturbances. So it is very important to study above discussed method that we have shown in this research paper in order to incorporate disturbance rejection. Where coordination is seen in limited communication between systems and constraints that got imposed on it. In this research paper we have analyzed the effect of rejection on step disturbance but we can also draw and simulate this model again to adjust the disturbance in the system so that control system properties can be preserved.

IV . COMPENSATION-C

In lead lag compensation, there is a combination of lead and lag arrangement .various drawbacks of compensation can be removed by using lead and lag compensation. Lead compensation has advantage of improvement in system response but at the same time we have one limitation that it does not give any idea about study state error. So in order to remove this limitation we need to use lag compensation .however we suffer with decrease in bandwidth that results in serious effects in system response. So the needs of lead lag compensation arise. Among the simplest dynamic structures used in compensator design is the lead-lag compensator. A lead-lag compensator has a transfer function of the form.

$Gc(s) = [(s+z_1)(s+z_2)] \div [(s+p_1)(s+p_2)]$

Where z_1 & z_2 are Zeros p_1& p_2 are poles.

In this research paper we used this compensation c to enhance the performance of an operational amplifier. An op amp is different from the other control systems .compensator design problems for op amps are mathematically similar to compensator design problems for more conventional control systems such as a servomotor.

To improve the response speed, edit the selected dynamics of the compensator. Dynamic have different values for:

1. Location
2. Damping
3. Frequency.

V. ALGORITHM FOR LQG SYNTHESIS

In order to obtain the results of analysis, we need MATLAB software with the help of this software it is possible for me to find and analyze the effect of step disturbance .We divide the whole algorithm into various steps.

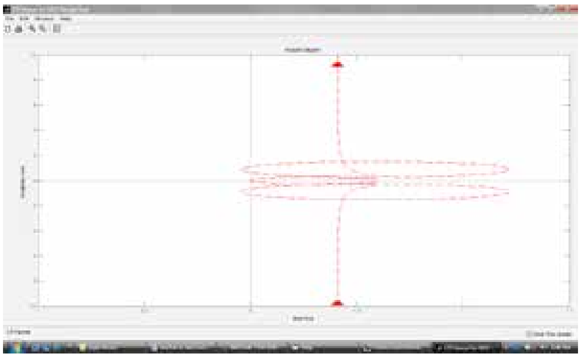
Step 1- Click on automated tunings tab of control and estimation tool manager.

(a) Select LQG synthesis from the design method option tab.
(b) Click on update compensator .The value of compensator C appears.

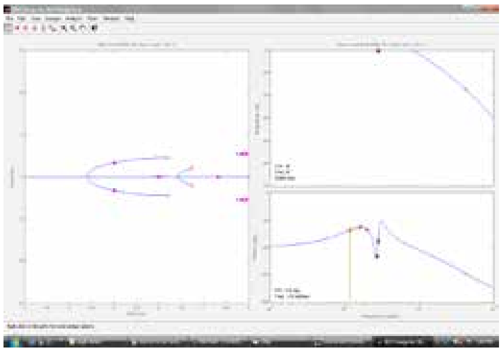
C=0.93498×[(1+0.95s+(0.61s) ˆ2)(1+0.25s+(0.35s ˆ2) ÷s(1+0.23s)(1+0.5s)(1+0145s+0.35ŝ 2]

Step2- click on analysis plot from control and estimation tool manager.

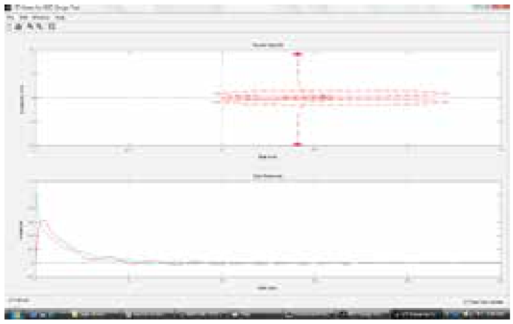
(a) From plot type, select niquist plot.
(b) Select compensator c from all the mentioned responses.
(c) Click to show analysis plot.



Step3- Click on show design plot from control and estimation tool manager.
(a) SISO design for SISO design task window appears like this.



(b) Click on analysis option from SISO design for SISO design task.
(i) Click on rejection of step disturbance then window of LTI viewer for SISO design task will appear like this.



Step4- Click on compensator editor from control and estimation tool manager .In this section we will see dynamic values of poles and zeros to know variations different values of location, damping and frequency.

S.NO	Pole/zero type	Location	Damping	Frequency
1	Real Pole	-42.8	1	42.8
2	Real Pole	-2.01	1	2.01
3	Integrator	0.0	-1	0
4	Complex	-1.27+/-...	0.775	1.64
5	Complex	-0.102+/-...	0.359	2.84
6	Complex	-0.0526+/-...	0.0192	2.74

VI. CONCLUSION

Control strategies have been recognized as an efficient way to improve building process automation.Linear quadratic-Gaussian (LQG) control problem is one of the most fundamental optimal control problems. So in order to solve and analyze this problem we determine location, damping and frequency values so that we can adjust the values by the compensator c to reduce these kinds of step disturbances that will not disturb the actual condition of the control system. LQG tracker design generates a closed loop controller that guarantees stability. It also contains an integrator, which guarantees zero steady-state error.

REFERENCE

[1] Robust nonlinear control design of a nonlinear uncertain system with input coupling and its application to | Hypersonic flight vehicles," in Proc. Multi-conference on Systems and Control, Yokohama, Japan,2010 | [2] W. B. Dunbar. Distributed receding horizon control of dynamically coupled non-linear Systems. | IEEE Transactions on Automatic Control, 52:1249– 1263. | [3] D.S. Bernstein and A. N. Michel "A chronological bibliography on saturating actuators, Int. J. Robust | and Nonlinear Contr., vol. 5, pp. 375-380 | [4] Liu, Ming, Egan, Gregory and Ge,Yunjian, Identification of Attitude Flight Dynamics for Unconventional | UAV" Proc.of IEEE/RSJ International Conference on Intelligent Robots and Systems, Oct. 9-15, Beijing, | China. | [5] Z. Gao. "Active disturbance rejection control : a paradigm shift in feedback control system design , | " Proceedings of the American Control Conference, 2399-2405. | [6] Q. Zheng, L.Q.Gao, and Z. Gao, "On Estimation of Plant Dynamics and Disturbance from Input-Output | Data in Real Time," Proceedings of the 16th IEEE International Conference on Control Applications, | 1167-1172. | [7] W. B.Dunbar. Distributed receding horizon control of dynamically coupled non-linear systems. IEEE | transactions on Automatic Control, 52:1249– 1263. | [8] W. Li and E. Todorov (2004) . Iterative Linear Quadratic Regulator Design for Nonlinear Biological | Movement Systems. In proceedings of the 1st International Conference on Informatics in Control, | Automation and Robotics, 1: 222-229 | [9] O. von Stryk (1993). Numerical solution to optimal control problems by direct collocation. International | Series on Numerical Mathematics- ics 111: 129-14310] A. Yahiaoui, J. Hensen, L. Soethout and D. Van Paassen, Appling advanced control strategies in building | Performance simulation runtime coupling Proc.8th REHVA World CLIMA,Lausanne Switzerland,2005. |