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DESIGNING OF A CONTROLLER BY USING MODEL ORDER REDUCTION TECHNIQUES

Deepak Kumar Mahto[1] and Jasvir Singh Rana[2]
[1]Department of Electronics and Communication Engineering, Research Scholar, Shobhit University, Gangoh, Saharanpur, India
[2]Department of Electronics and Electrical Engineering, Prof. & Head, Shobhit University, Gangoh, Saharanpur, India
E-Mail: deepak.deepak2510@gmail.com, jasvirsingh.rana@shobhituniversity.ac.in

Abstract—Physical modeling usually involv es more than two higher order processes. Designing a controller for such a physical body becomes tedious when the verdict is high. Therefore, it is desirable to estimate this model by specifying the model. In this paper, model order reduction is obtained b y cloud clustering and factorization algorit hms. The controller is designed for low- order models, cascaded through the origin al process to achieve certain guidelines.
The plan guarantees the security of the sy stem in case the orders decrease. The plan is illustrated with a numerical example.
Keywords– Pole group, sequence reduction, factors, distribution, stability, power vari ation, PID controllers.

I. INTRODUCTION

The quality of the reduced decision model de pends on how it is used and how well it represe nts the desired features of the system. One of t he main purposes of order reduction is to create a lower order that can control the order of the o riginal, making all orders lower and easier to un
understand. Therefore, it is important for the de motion model to reduce decisions to lower man agement to avoid making too many mistakes. D ownsizing the model is based on open-loop deci sin while the main concern in the design is close d-loop stability performance. The Pade approach [1,2] is a reduced model for decision making.
This provides flexibility of the model after conve rsion to a reduced-order model. Different techni ques can be used to simplify the model and the result is a stable model. In this way, numerical Coefficients from the ratio [3,4] and numerical c oefficients from the pole group [5,6] can be obt ai
Various methods [7, 8, 9, 10 and 11] have been developed to design PID controllers. In this pape r, a simple algebraic scheme is presented to des ign a PID controller for a linear time-invariant co ntinuous system.
The closed-loop transfer function of the reduced
-order model with PID controller is compared wit h the model using the transfer function in the

fr equency range.

II PROBLEM STATEMENT

2.1. PID controller switching functionThe PID controller can be numerically displayed as[12],

u(t)=k 1 [e(t)+ 1 T j int 0 ^ t e(tau)d+ T_{d} * (de(tau))/(dt) (1)

where u(t) and e(t) represent the check and e rror of the system is the proportion gain, and represents the integral and derivative time constants respectively. The corresponding PID controller transfer function is given as

G_{c}(s) = k_{1}[1 + 1/(T_{i}*s) + T_{d}*s] (2)E

(2)Equation (2) can be rewritten as

G_{c}(s) = k_{1} + k_{2}/s + k_{3} (3)

k_{1}, k_{2} and k_{3} are represents the proportional, integral and derivative gain values of the controller 2.2. Higher Order Transfer Function Let higher order system or process whose performance is unsatisfactory may be described by the transfer function

G c (s)= N(s) D(s) = A_{21} + A_{22}s +
A_{23} * s ^ 2 +* A 2n s^ n-1 A 11 +A 12 s+A13 S^ 2 +**.A 1,n+1 s^ n (4)

And a reference model having the desired performance is given.

2.3. Lower Order Transfer Function

Find the rth subsection pattern for the above co ntinuum where r < n in the graph, such that the lower order model retains the characteristics of the original system and approximates its The answer is as close as possible to the same type of feedba ck.

R(s)=

a_{21} + a_{22}s + a_{23} * s ^ 2 +* A 2r s^ r-1 a 11 +a 12 s+a 13 S^ 2 +**.a 1,r+1 s^ r+1

Where, a_{2i} and a_{1i} are scalar constants.

The goal is to provide a controller that matches
the performance of the augmentation to the ref erence model. High resolution is reduced to sub- seconds to reduce computational complexity an d implementation complexity. PID controllers ar e also derived for reduced orders.

II. REDUCTION METHOD

The simplification process to get the #row si mplification model consists of the following two steps:

Step 1: Determine the denominator polynomial of the order simplification model using the conn ection method "-operation modulo, because eac h group can be replaced by a real pole, pole, ma
x. is the group that uses the following rules to o btain a reduced-order model.

i. Roads cluster should be made for real poles and complex pole

ii. The poles of the jw axis must be kept in reduc ed form. Cluster positions can be created using a simple method called the "inverse distance

metric" is defined as: Let r be the real pole in the group, the n the inverse distance metric (IDM) standard sh ows groups based on groups.

p c =\ (Sigma i = 1 ^ r (1 p i))/ r\ ^ -1 (6)

Where pc is cluster center from r real poles of the original system. Then denominator polynomial for order reduced model can be obtained as

D k (s)=(s-p c1)(s-p c2)...........(s-p ck) (7)

Where p cl ,p c2 ,...p ck are 1st,2nd...kh cluster center

Step-2: Determination of the numerator of k ^ (th) order reduced model using Factor Division algorithm [4] After obtaining the reduced denominator, the numerator of the reduced model is determined as follows

N k (s)= (N(s))/(D(s)) * D k(s) = N(s) D(s)/ Dk(s) (8)

(i) Where D_{k} (s is reduced order denominator. There are two approaches for determining of numerator of reduced order model. (i) By performing the product of N(s) and D_{k}(s) as the first row of factor division algorithm and D(s) as the second row up to s ^ (k - 1) terms are needed in both rows.

(ii) By expressing N(s) * D_{k}(s) / D * (s) as N(s) / [D(s) / D_{k} * (s)] and using factor division algorithm twice; the first time to find the term up to s in the expansion of D(s)/D(s) (i.e. put D(s) in the first row and D(s) in the second row, using only terms up to s ^ (k - 1)) The second takes N(s) on the first line and expands [D(s) / D _{k} * (s)] on the second line. Therefore the numerator N(s) of the reduced order

model (R_{k}(s)) in eq .(4) will be the seriesexpansion of

N(s) D(s) D k(s) = sum l=0 ^ k-1 c ls ^ l sum nl=0 ^ k d l s^ l (9)

About s = 0 up to term of order s ^ (k – 1)

p 0 =p 1 - alpha k - 2 h 1

Therefore, the numerator N_{k}(s) * ofeq .(2) is given by
N k (s)= Sigma i = 0 ^ k-1 propto i s^ i

(10)

IV GENERAL ALGORITHM FOR DESIGNING The PID Controller

Proportional-integral-derived (PID) controllers ar e control concepts commonly used in engineerin g applications. The general algorithm for designi ng a PID controller using the reduction model ca n be done in the following steps:

Obtaining the mathematical model of the syste m to be controlled: The first step is to obtain the Mathematical models describing the behavior of the controlled system. . This can be done

using first principles, empirical data or systems analys is techniques.
Determine the required closed-loop features: Th e next step is to determine the required closed-loop features of the system, such as persistent errors, messages Continuous response, and sec urity standards.

Designing High-Order PID Controllers: High-end PID controllers are designed from mathematical models and features that need to be turned off. The proportional gain, single gain and variable g ain parameters of the PID controller are selecte d according to the system dynamics.

Model Downgrade: PID controller decisions are t hen downgraded to a lower-order controller usin g model reduction. Minimization methods may i nclude proportional equations, normal interactio n analysis, or deterministic agent minimization.

Adjusting the Reduced Order PID Controller: The reduced order PID controller is then tuned to meet the desired closed loop characteristics of the system. The repair process will adjust the PID p arameters to meet the required stability, sustai ned response, and stability standards.

V. NUMERICAL EXAMPLE

SN	*parameter*	*G(S)*	R2 (s)	*R cl (s)*
1	Rise Time(Sec)	2.4746	4.343	2.3556
2)	Settling Time(Sec)	6.455	5.7554	6.777
3	Peak Time(Sec)	4.3214	4.565	9.7654
4	Overshoot	0	0	5.9253
5	Peak	4.6432	3.5666	2.576

VI. CONCLUSIONS

In this study, in linear single-input single-output high-order system reduction scheme, the denominator polynomial of the reduction model isdetermined by clustering method and calculat without dividing the numerical coefficient. Later the PID controller was designed as a reduced m odel. The proposed algorithm is illustrated with a numerical example. Figure 1 shows a compari son of the step response of the first and simplifi ed quadratic systems and a comparison of the standard and closed-loop step response.
The reduced sequence after adding the PID c ontroller to the loop is shown in Figure 2. Table 1 provides a comparison of various parameters ba sed on the original and quadratic models and im plicit response. The process is simple, smart an d takes less time

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