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Designing PID Controller Using improved Differential-Pole-clustering Approach of Model Order Reduction Techniques

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ABSTRACT

The method of mathematical modelling that takes into account various physical systems, such as various tele-communications, High voltage transmission, and various chemical reactors, ultimately produced a variety of solutions for bigger order complex mathematical models with higher order. Order reduction is essential for such higher order systems (HOS) for reducing mathematical complexity for designing controllers. In order to improve upon several existing model order reduction approaches, the goal of this paper is to solve difficult higher order models using Differential Pole Cluster Mixed (DPM) Techniques. The accuracy of the proposed reduced model has been made via comparing step responses of original and reduced order models. In order to improve upon several existing model order reduction approaches. The higher order system PID Controller has been made using the proposed reduced-order approach.

Keywords- Order Reduction theory; Differential Pole Cluster mixed Technique (DPM); Pole clustering; Stable System; Error-minimization; Controller-design.

INTRODUCTION

The model-order-reduction (ROM) of HOS is frequently useful for building an effective controller for a healthier form of system and reducing computing complexity. The essential goal of ROM is to simplify the relationship between higher-order systems (HOS) and the necessary reduce-order model (ROM) while maintaining a modicum of estimation security (HOS). Routh approximation is one of the most prominent approaches in terms of ROM, and it has been noted in this paper that many conventional methods for ROM can be further enhanced with the use of optimization techniques (A. Sikander et. al. 2015). Alternative Model order reduction technique has been developed with help of balance truncation methodology (A.K Prajapati et. al. 2020). In the paper Sinha and Pal implemented a newer approach towards ROM using pole clustering method and later on clustering technique has been improved (J. Singh et. al. 2016). But this technique gives us unstable systems sometimes while the original system is stable one. So, in this paper further the technique has been improved with the help of DPM. After improvement this technique gives us much better response matching with original HOS accurately and also minimizes the error while DPM involved along with pole clustering technique. Pole clustering technique reduces the model up to 3rd order but in proposed method it has been further more reduced with better value of approximation-results. A flexible closed-loop (FCL) PID and PID fuzzy investigation is described with various controls can be turned on for various times and places during the motor's whole running period (Can.E.et.al.2021). Another way a highly effective CSI feed The suggested IFOC is based on closed-loop PWM control that uses AC hysteresis

(Mondal.Aet.al.2020). Another method which well known that is differential technique but it gives us large steady state error when the original system has very large order (Kharitonov et. al. 1985). In paper of Othman & Adnan, the true dominant poles are designated built on the uppermost input in rearranged time moments and lowest influence in rearranged Markov parameters has been taken into consideration to solve the model order reduction problem (O.Alsmadi et. al. 2020*)*.

The enduring paper is organized as in Sect. 2; the problem statement of the model reduction scheme. The elementary dealings of the proposed reduction technique with existing techniques upgradation are defined in Sect. 3. In Sect. 4 the controller designing approach has been illustrated. In Sect. 5, five common mathematical illustrations are considered from the existing works for the authentication of proposed methodologies. The supposition of the paper is described in the part sec.6.

PROBLEM STATEMENT

Let, us replicate on a HOS that is expressed here by the transfer function (TF) uttered as:

$$G(s)=\frac{h_0+h_1s+h_2s^2+h_3s^3+........+h_ms^m}{g_0+g_1s+g_2s^2+g_3s^3+........+g_ns^n} \qquad \text{where, } n>m \qquad (1)$$

The suggestion is to establish a reduced r-th order model that has a TF ($r<n$)

$$R(s)=\frac{p_0+p_1s+p_2s^2+p_3s^3+........+p_ps^p}{q_0+q_1s+q_2s^2+q_3s^3+........+q_rs^r} \qquad \text{where, } r>p \qquad (2)$$

Now, this HOS of n-th order is reduced to r-th order by projected techniques i.e by improvement of ROM techniques like pole clustering and differential approach improvement with help of DPM.

Review on Differential Approach

The differential approach first introduced by (P.Gutman et. al. 1982). The procedure is approach on reduction of the order of polynomials of numerator and denominator with help of differentiation. The unswervingly frontward differentiation is laid off because it has a snare that zero by means of big modulus be expected to be enhanced approximated than with an short modulus (D. Sambariya et. al. 2012, S.S. Mukherjee et. al. 2012).

Pole clustering technique of order reduction review (S. Arun et. al. 2020)

In pole clustering techniques higher order system is divided into two different clusters combination of real poles and imaginary pole. But this method has two major disadvantages that is in this method we cannot get model of order other than 3rd and also this method needs to add a steady state error correction factor or gain adjustment factor indeed. In this paper, this major drawback has been improved using mixed approach.

Adopted proposed mixed approach for developing ROM

The improved methodology towards ROM is illustrated as algorithm as follows-

Step 1: Higher order complex system has been taken and its numerator and denominator part are taken separately for adopting the technique. $G(S)=\frac{N(S)}{D(S)}$

Let us consider the denominator polynomial and it has been reciprocated as-

$$D(s) = b_n + b_{n-1}s^{n-n+1} \ldots + b_3 s^{n-2} + b_2 s^{n-1} + b_1 s^n$$

Step 2: Now, we will differentiate the reciprocated polynomial multiple times depending upon the highest order of the denominator (only after twice differentiation the order obtained) such as-

$$D(n-4)(s) = 0 + \frac{b_{n-4}(3)!s}{1!} + \ldots + \frac{b_3(n-2)!s^{n-6}}{(n-6)!} + \frac{b_2(n-1)!s^{n-5}}{(n-5)!} + \frac{b_1 n! s^{n-4}}{(n-4)!}$$

Step 3: For getting improved and easier calculation in 4th order system pole clustering method adopted and cluster canter formed with help of –

- From higher order system poles $P_1, P_2, \ldots P_r$ are find for formation of cluster P_{cr}. Two separate clusters has been formed for real and imaginary poles. In imaginary part if n number of complex conjugate poles are present such as [(σ1±jὼ1),(σ2±jὼ2),………(σr±jὼr)]are present ,the cluster is formed separately for real part of complex set and imaginary part of complex set.

$$Cc_r = [\sum_r^k (\frac{-1}{|P_r|}) \div k]^{-1}$$
$$r = r+1$$

$$Cc_r = [(\frac{-1}{|P_1|} + (\frac{-1}{Cc_{r-1}})) \div 2]^{-1} \text{ and reduced denominator of 3}^{rd}\text{order considering the following}$$

Now, reduced denominator developed as per following-

(i) If poles are only real one present in cluster- $D_r(S)=(S-Pc_1)(S-Pc_2)....(S-Pc_r)$

(ii) If poles are complex in cluster-$D_r(S)=(S-\breve{\alpha}_{c1})(S-\breve{\alpha}_{c2})....... (S-\breve{\alpha}_{r/2})$

(iii) If poles are both real and imaginary present- $D_r(S)=(S-Pc_1)...(S-Pc_r)....(S-\breve{\alpha}_{c1})$

Step 4: For getting 2nd order reduced model we will apply routh technique for developing stable simple reduced system denominator $D_r(S)$.

Step 5: The steps can be followed for developing reduced numerator part $N_r(S)$ of the high order complex system.

Step 6: Now, reduced numerator and denominator together formed reduced order stable model of 2nd order system. $R(S)=\dfrac{N_r(S)}{D_r(S)}$ Here, 8th order fixed-missile system, Regulator of 6th order ,fuel control of 4th order has been taken for consideration as example for numerical results of proposed technique.

DESIGN ASPECTS OF PID CONTROLLER

The design of a controller besides simulating a large order system is very lengthy and complex work. As the difficulty increases the simulation period and cost of designing controller increase simultaneously. To overcome these types of complexities a "good" approximation of higher model can be determined from this complex model and controller can be formed by using the reduced simple approximated lower order model.

General structure algorithm for design controller:

For getting desired results of real-time dynamic-system, a reference model M(S) is calculated on the source of specified specification.

Step1: Construction of a reference model M(S) on the basis of specifications whose close loop system must approximate to that of the original closed loop response.

$$M(\mathrm{s})=\frac{a_0+a_1s+..........+a_ms^m}{b_0+b_1s+..........+b_ns^n} \quad (3)$$

Step 2: Determine an equivalent open loop specific Model- $\tilde{M}(\mathrm{s})=\dfrac{M(\mathrm{s})}{1-M(\mathrm{s})}\left(4\right)$

Step 3: Specification of the structure of the controller $-G_c(\mathrm{s})=\dfrac{p_0+p_1s+..........+p_ms^m}{q_0+q_1s+..........+q_ns^n}$ (5)

Step 4: For determining the unknown control parameters the response of closed loop system

$$G_c(\mathrm{s})=\frac{\tilde{M}(\mathrm{s})}{G(\mathrm{s})}=\sum_{i=0}^{\alpha}e_is^i \quad (6)$$

Where, e_i are the power series coefficients about s=0,Now the unknown controller parameters pi and qi are obtained by equating the equation in pade sense(Y.Shamesh et. al. 1975).

$$p_0 = q_0 e_0$$
$$p_1 = q_0 e_1 + q_1 e_0$$
$$.$$
$$p_i = q_0 e_i + q_i e_{i-1} \ldots\ldots + q_i e_0$$
$$0 = q_0 e_{i+j} + q_i e_{i-1} + \ldots\ldots + q_i e_j$$

Step 5: Comparing equation (5) & (6) the desired controller parameter can be obtained .

Step 6: After obtaining the controller parameters the closed loop transfer function

can be obtained as- $G_{cl}(\mathrm{s}) = \dfrac{G_c(\mathrm{s})G(\mathrm{s})}{1 + G_c(\mathrm{s})G(\mathrm{s})}$

Step 7: By repeating step 4 and 5 the closed loop transfer function for reduced model can be determined as follows- $R_{cl}(\mathrm{s}) = \dfrac{R_c(\mathrm{s})R(\mathrm{s})}{1 + R_c(\mathrm{s})R(\mathrm{s})}$

SIMULATION RESULTS WITH PRACTICAL SYSTEM MODELS

The reduced model is verified in terms of different performances index like integral absolute error (IAE), relative integral square error (RISE), integral-time-weight absolute error (ITAE) and the performance error indices are described(G. Kotsalis et. al. 2010, A. Buscarino et. al. 2016)as-

$$ISE = \int_0^\infty \left[g(t) - \mathrm{g}_r(t) \right]^2 dt,\ RISE = \int_0^\infty \left[g(t) - \mathrm{g}_r(t) \right]^2 dt \Big/ \int_0^\infty [\hat{g}(t)]^2 \qquad (7)\text{-}(10)$$
$$IAE = \int_0^\infty \left| g(t) - \mathrm{g}_r(t) \right|^2 dt\ ,\ ITAE = \int_0^\infty t \left| g(t) - \mathrm{g}_r(t) \right| dt$$

Where g(t) and g_r(t) are the unit step responses of the original system and the abated system, respectively. In addition, gˆ(t) is the impulse response of the original practical system.

Example 1: Considering another real system (J. Singh, et. al. 2020) of flexible-missile-control system $G(s) = \dfrac{-s^6 + 3.06x10^2 s^5 - 4.96x10^4 s^4 + 3.577x10^6 s^3 - 6.303x10^7 s^2 - 1.246x10^{10} s + 5.906x10^{11}}{s^8 + 52.99 s^7 + 3.05x10^4 s^6 + 1.375x10^6 s^5 + 1.839x10^8 s^4 + 5.232x10^9 s^3 + 3.422x10^{11} s^2 + 2.823x10^{12} s + 1.442x10^{14}}$

For developing reduce order system following steps has been considered according to the steps given in proposed method.

Step1: Choose the denominator transfer function and reciprocate the transfer function

$$1+52.99s+3.05x10^4s^2+1.375x10^6s^3+1.839x10^8s^4+5.232x10^9s^5+3.422x10^{11}s^6+2.823x10^{12}s^7+1.442x10^{14}s^8$$

Step 2: Now we will differentiate the 8th order denominator twice and reduce it to 6th order-

$$6.10x10^4+8.25x10^6s+22.068x10^8s^2+104.64x10^9s^3+102.65x10^{11}s^4+118.944x10^{12}s^5+80.752x10^{14}s^6$$

Step 3: Now after calculating the poles we got -0.4674 ± 1.5515i , -0.1919 ± 0.6692i , -0.0169 ± 0.322i

Now, clustering of real part of complex poles- $P_A=\left[(-\frac{1}{0.4674}+\frac{-1}{0.1919}+\frac{-1}{0.0169})/3\right]^{-1}$ =0.00447

Now, clustering of imaginary part of complex poles- $P_B=\left[(-\frac{1}{1.5515}+\frac{-1}{0.6692}+\frac{-1}{0.322})/3\right]^{-1}$ =0.1907

Step 4: considering the clustering of poles we get the denominator-D(s)= $\left(s+0.00447\pm j0.1907\right)$

Step5: finally, the 2nd order denominator obtained by obtained in step 4. D(s)= $s^2+0.0088s+0.05396$.

Step 6: Now calculating numerator in similar way and multiplying with weight gain adjustment we get-Proposed differential –pole clustering mixed method 2nd order reduced T.F- $Rm(s)=\frac{-0.10896s+2.7984}{s^2+1.0822s+684.22}$

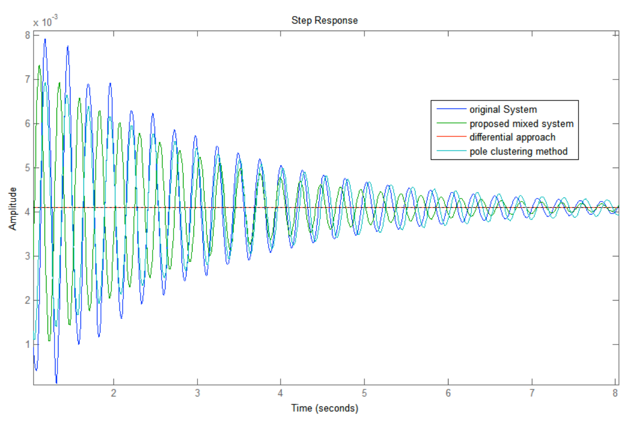

Figure 2 Step Responses of Original system with Reduced Models

Table 1: Comparisons of different Parameters of Reduced order Model with Original System

Reduction methods	*Reduced-order models*	*ISE*	*RISE*	*IAE*	*ITAE*

Balanced Truncation	$\frac{0.0209s+0.0132}{s^2+0.2345s+0.0132}$	0.1856	0.1255	4.9856	53.326
Pole Clustering	$\frac{-6.8192s+0.7032}{s^2+3.9244s+0.7032}$	61.1104	43.2856	100.82	1254.46
Differentiation method	$\frac{216s+715}{3742s^2+4031s+722}$	33.8684	23.647	99.249	1410.22
Stability Equation and continued fraction	$\frac{0.3139s+2}{137.1s^2+30.6s+2}$	0.3651	0.2586	11.056	275.866
Factor division and stability equation	$\frac{-0.0067s+0.02}{s^2+0.23s+0.02}$	0.3651	0.2379	7.5084	93.5032
Proposed method	$\frac{-0.10896s+2.7984}{s^2+1.0822s+684.22}$	**0.1633**	**0.1158**	**4.85**	**52.2456**

Example 2: Let us consider a practical higher order system of Regulator, the values has been taken of a particular practical system- $G(s)=\dfrac{2s^5+3s^4+16s^3+20s^2+8s+1}{2s^6+33.6s^5+155.94s^4+209.5s^3+102.42s^2+18.3s+1}$

Proposed Differential Pole-clustering mixed (DPM) method- $Rm(s)=\dfrac{1.538s+0.2496}{s^2+2.3684s+0.2486}$

Example 3: Considering the same (Example 2)6th order Regulator System along with its reference plant for the design of PID Controller. Consider the full order model of Regulator-

$$G(s)=\frac{\Delta V_t(s)}{\Delta V_{ref}(s)}=\frac{2s^5+3s^4+16s^3+20s^2+8s+1}{2s^6+33.6s^5+155.94s^4+209.5s^3+102.42s^2+18.3s+1}$$

And reduce model calculate by DPM method $-Rm(s)=\dfrac{1.538s+0.2496}{s^2+2.3684s+0.2486}$

Now, for this 2nd order model the reference model has been chosen using damping ratio ζ and natural frequency (ω_n) $-M(s)=\dfrac{0.1101}{s^2+s+0.1101}$

Now open loop transfer function of the reduced model using reference model obtained as-

$$\tilde{M}(\mathrm{s})=\frac{0.1101s^2+0.1101s+0.01212}{s^4+2s^3+1.11s^2+0.1101s}$$

The controller structure is given by-

$$R_c(\mathrm{s})=\frac{0.1101s^4+0.3709s^3+0.3003s^2+0.05608s+0.003014}{1.538s^5+3.326s^4+2.207s^3+0.4464s^2+0.02748s}$$
$$=\frac{1}{s}(0.1096+0.1256\mathrm{s}+0.136\mathrm{s}^2-1360.670\mathrm{s}^3-\ldots..)$$

Taking PID controller as follows and Comparing (5) & (6) we get

$$R_c(\mathrm{s}) = k_p + \frac{k_i}{s} + k_D s, k_p = 0.1256, k_i = 0.1096, k_D = 0.136, R_c(\mathrm{s}) = 0.1256 + \frac{0.1096}{s} + 0.136s \qquad (11)$$

The closed loop transfer function of Reduced regulator with controller is obtained as-

$$R_{cl}(\mathrm{s}) = \frac{0.2092s^6 + 0.7225s^5 + 0.7898s^4 + 0.5573s^3 + 0.1145s^2 + 0.006801s}{1.209s^6 + 5.459s^5 + 6.896s^4 + 1.735s^3 + 0.1763s^2 + 0.006801s}$$

Considering the same values of PID controller parameter the original regulator with controller transfer function obtained as-

$$G_{cl}(\mathrm{s}) = \frac{\begin{array}{c}0.544s^{14} + 10.46s^{13} + 70.11s^{12} + 263s^{11} + 778.9s^{10} + 1629s^9 + 2305s^8 + 2245s^7 \\ + 1502s^6 + 671.5s^5 + 192s^4 + 32.9s^3 + 3.008s^2 + 0.1096s\end{array}}{\begin{array}{c}4.544s^{14} + 144.9s^{13} + 1823s^{12} + 1.158x10^4 s^{11} + 3.958x10^4 s^{10} + 7.392x10^4 s^9 \\ + 7.937x10^4 s^8 + 5.093x10^4 s^7 + 1.997x10^4 s^6 + 4839s^5 + 731.7s^4 + 69.5s^3 + 4.008s^2 + 0.1096s\end{array}}$$

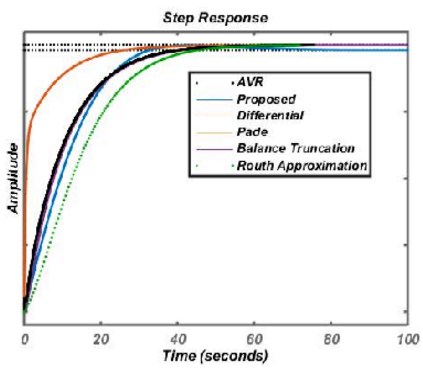

Figure2 (a)

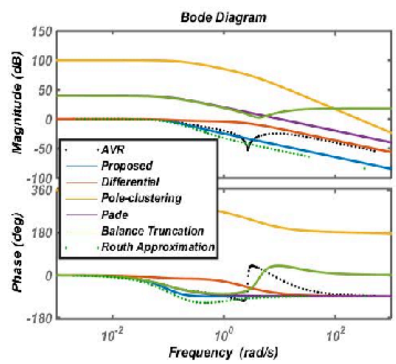

Figure2 (b)

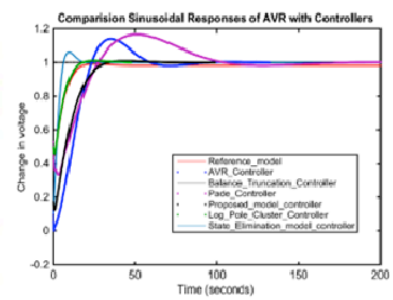

Figure2 (c)

Figure 2(a) & (b)Comparison of Step & Bode Responses of REGULATOR System and its reduced Models,

Figure 2(c) Comparison of Step Response including reduced model controller

Table 2 Comparisons of different Parameters of Reduced order Model with Original System

Reduction methods	***Reduced-order models***	***ISE***	***RISE***	***IAE***	***ITAE***
Balanced Truncation	$\frac{-0.1478s + 1.89}{s^2 + 1.1903s + 1441}$	9.8546 x 10^{-4}	0.0061	0.9910	49.9728
Pole Clustering	$\frac{-0.12396s + 5.904}{2.4389s^2 + 1.998s + 1441.87}$	2.1572x 10^{-4}	0.0014	0.0848	0.1768
Differentiation method	$\frac{-0.4178s + 118.89}{2.463s^2 + 142.23s + 29072}$	2.3423 x 10^{-4}	0.00146	0.0886	0.2402
Stability Equation and continued fraction	$\frac{-0.0267s + 2.4289}{s^2 + 11.577s + 591.193}$	2.4162x 10^{-4}	0.0015	0.0884	0.1778
Factor division and stability equation	$\frac{-0.1067s + 5.9067}{2.4399s^2 + 28.23s + 1441}$	2.1459x 10^{-4}	0.0016	0.0848	0.1763

Proposed method	$\frac{1.538s+0.2496}{s^2+2.3684s+0.2486}$	**1.7454x 10^{-4}**	**0.0009**	**0.0672**	**0.1207**

Table 3 Comparisons of different Parameters of Reduced order Model of regulator

Reduction Techniques	***Reduced Models***	***K_p ,K_i ,K_D***	***Rise Time***	***Settling Time***	***Peak Overshoot***	***Peak Time***
	Reference System	-	10.1673	26.4167	0.9912	25.0047
	Original System	-	14.6101	74.7166	1.1428	35.1905
Pole Clustering	$\frac{-0.12396s+5.904}{2.4389s^2+1.998s+1441.87}$	0.649, 1 ,0.3212	10.1672	28.4125	1.1034	25.008
Differentiation method	$\frac{-0.4178s+118.89}{2.463s^2+142.23s+29072}$	0.004, 1, 0.0637	9.1672	26.4166	0.9500	25.0028
Factor division and stability equation	$\frac{-0.1067s+5.9067}{2.4399s^2+28.23s+1441}$	1.8125, 0.9855,0.3566	9.1672	24.4166	0.8200	48.021
Proposed method	$\frac{1.538s+0.2496}{s^2+2.3684s+0.2486}$	**0.136,0.1256,0.1096**	**14.4941**	**46.8443**	**1.70172**	**51.0636**

Example 4: Let us consider a practical higher order system (O.Alsmadi et. al. 2020)

$$G(s)=\frac{18s^7+514s^6+5982s^5+36380s^4+122664s^3+222088s^2+185760s+40320}{s^8+36s^7+546s^6+4536s^5+22449s^4+67284s^3+118124s^2+109584s+40320}$$

The 2nd order reduced model obtained using Proposed technique $Rm(s)=\frac{6.824s+2.178}{45.19s^2+2.708s+2.178}$

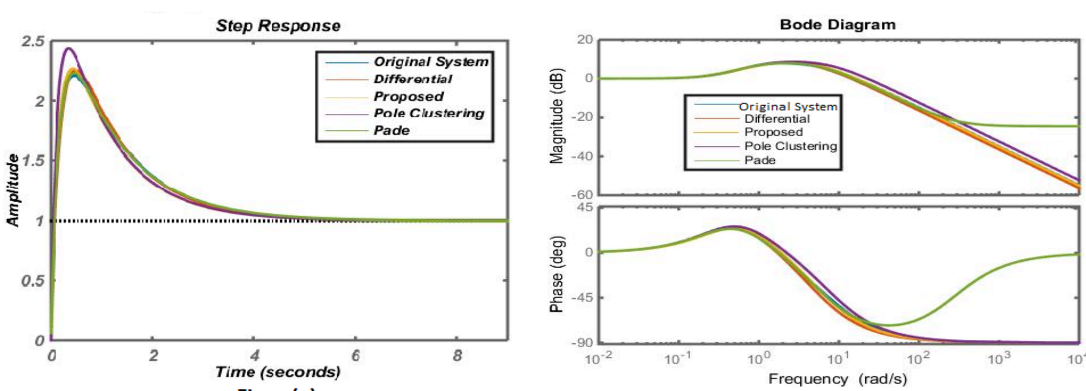

Fig. 4 (a) Fig. 4 (b)

Figure 4 (a)Comparison of Step Responses with original & reduced System (Example:4),(b) Comparison of Bode Responses with original & reduced System (Example:4)

Table 4 Comparisons of different Parameters of Reduced order Model of Example-4

Reduction methods	***Reduced-order models***	***ISE***	***Phase Margin***	***Gain Margin***	***Stability***
Balance Truncation	$Rm(s)=\frac{14.624s+3.90}{s^2+6.23s+3.90}$	***1.32 x 10-3***	***112***	***α***	***Yes***
Factor division and stability equation	$Rm(s)=\frac{17.624s+5.90}{s^2+7.23s+5.90}$	**1.37 x 10-3**	**114**	**α**	**Yes**
Pole Clustering	$Rm(s)=\frac{24.11s+7.89}{s^2+8.97s+7.89}$	***4.80 x 10-2***	**111**	***α***	***Yes***
Differential	$Rm(s)=\frac{11.378s+4.43}{s^2+4.22s+4.43}$	***5.68 x 10-2***	**112**	***α***	***Yes***
Proposed method	$Rm(s)=\frac{6.824s+2.178}{45.19s^2+2.708s+2.178}$	***1.29 x 10-2***	**114**	***α***	***Yes***

Example 5: Considering 4th order fuel control (L.A. Aguirre,1992) along with its reference plant for the design of PID Controller. $G(s)-\frac{s^3+12s^2+54s+72}{s^4+18s^3+97s^2+108s+100}$

And reduce model calculate by Proposed DPM method – $Rm(s)=\frac{0.627s+1.48}{s^2+3.01s+2.03}$

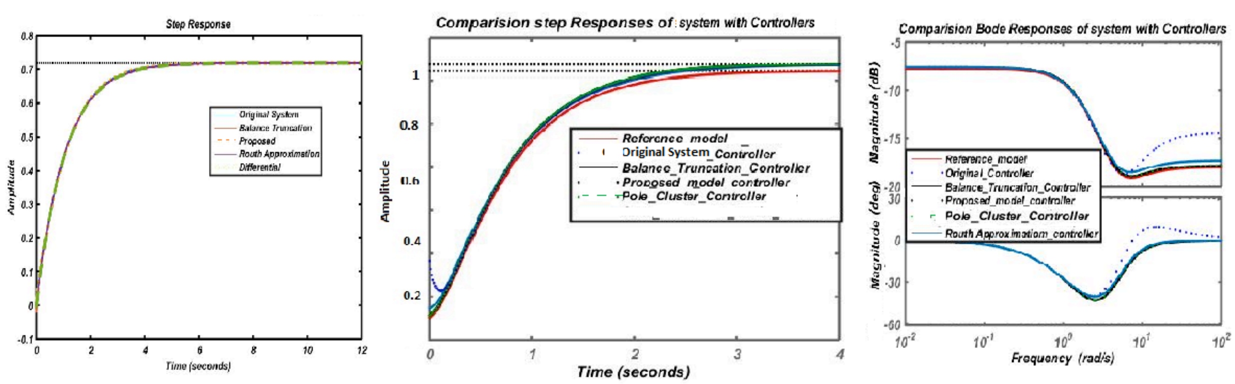

Figure 5 Fuel Control System & reduced order Controller comparison of Step & Bode Responses

Table 5: Comparisons of different Parameters of Reduced order Model

Reduction Techniques	*Reduced Models*	K_p, K_i, K_D	*Rise Time*	*Settling Time*	*Peak Overshoot*	*Peak Time*
	Reference System	-	2.314	4.0226	0	7.7084
	Original System	-				
Balance Truncation	$\frac{5318s+4104}{7939s^2+13460s+5700}$	9.642,13.25, 1.4516	2.26	4.036	0.8932	7.9391
Pole Clustering	$\frac{4.846s+584.9}{s^2+866.8s+812.4}$	11.649,12.36 ,0.3212	2.27	4.1226	0.7231	8.7391
Differentiation method	$\frac{-0.4178s+118.89}{2.463s^2+142.23s+29072}$	4.89, 12.54, 1.0637	2.275	3.9666	0.8612	7.8399
Factor division and stability equation	$\frac{-0.0626s+1.89}{s^2+4.478s+485.2}$	9.89,11.25,1.33	2.29	4.26	0.8111	7.1491
Proposed method	$\frac{0.627s+1.48}{s^2+3.01s+2.03}$	**10.54,12.285,1.236**	**2.28**	**4.0026**	**0.7211**	**7.7391**

Figure 2,4,5 show different comparison of step & bode responses of the example taken original system and the closed loop models including controller (PID) obtained by large-order system and the reduced models. Table 1,2,4 are showing different parameters comparison of some existing techniques along with proposed one. The specifications in time domain of closed loop system including controllers are given in Table 3,5. In the table 3,5 shows $K_{P,}$ K_D, K_I along with different characteristics parameters are compared for reduced model developed by proposed method and also other existing methods. From these above responses and comparison of parameters in table 4,5 shows the robustness of the controller.

ESTIMATION OF PROPOSED ALGORITHM

Proposed technique combinedly the having the subsequent significant features: (1) If a Stable higher-order system is taken then obtained proposed reduced system will also maintain its stability. (2) The projected approach does not need gain adjustment factors and tuning for the appropriate matching of dynamic as well as static responses. (3) The projected algorithm is computationally very simple. (4) The projected method also eliminates the problem associated with differential method as well as pole-clustering technique (5) Controller development also became very simple and computationally efficient in the approached methodology.

CONCLUSIONS

The most important advantage of the adopted method does not engage difficult mathematical approaches of optimization method and is easy to execute in a little number of seconds. The concert assessment is ended on the source of error calculations techniques such that ISE, IAE, ITAE with former method obtain with minimum errors. The usefulness of the projected technique is that characteristics to carry out superior approach than former accepted technique existing in the narrative and also indicates easier mathematical approach indeed.

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