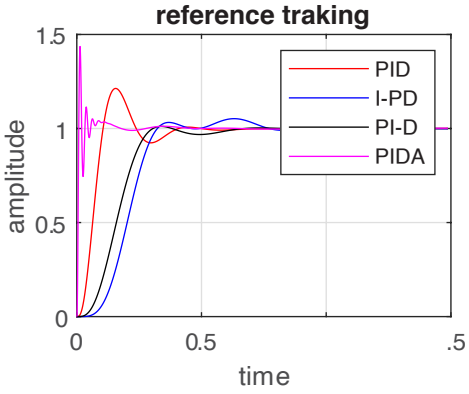
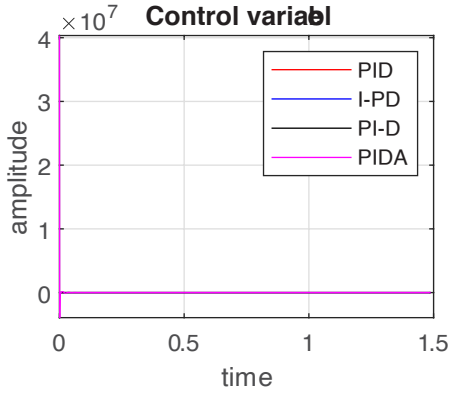
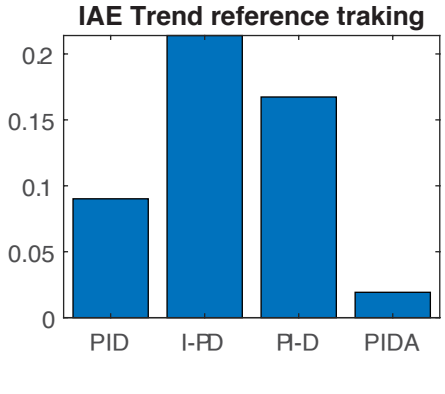
Fourth Order System 0,2

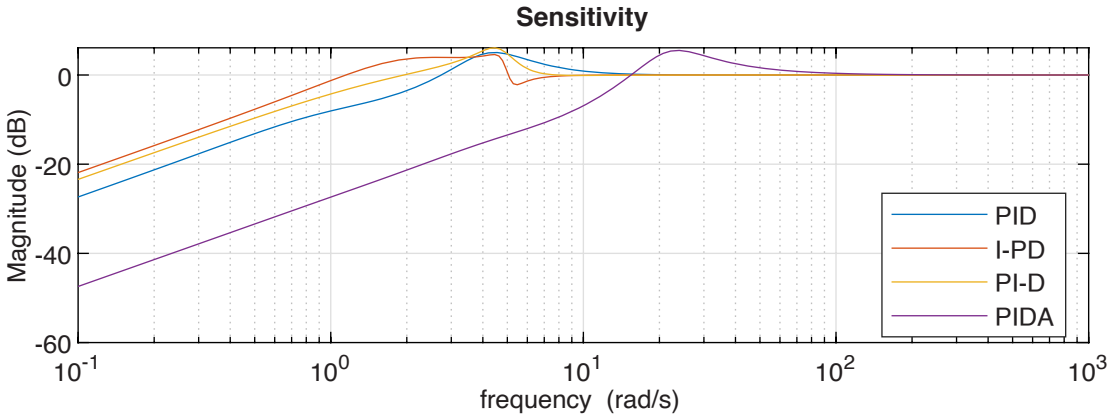
$$G(s) = \frac{1}{(s+1)(0.2s+1)(0.2^2 s+1)(0.2^3 s+1)}$$

Set Point Optimization

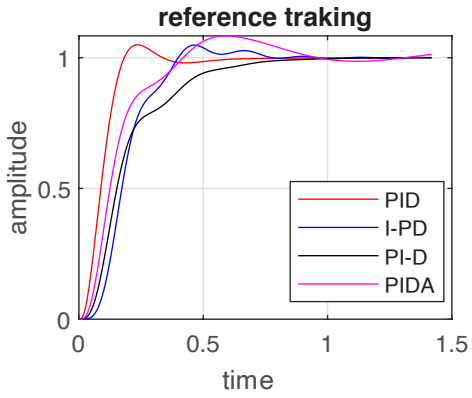


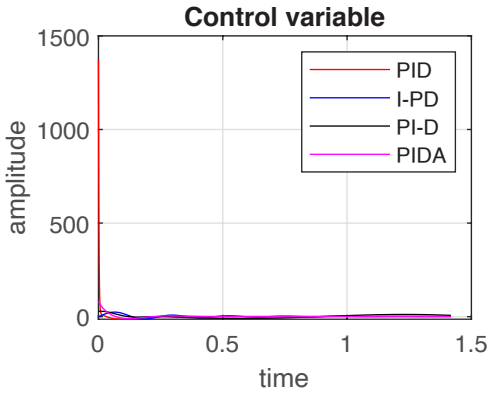


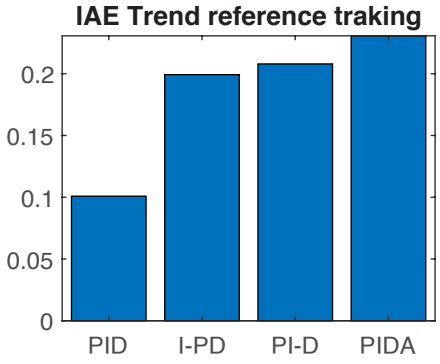


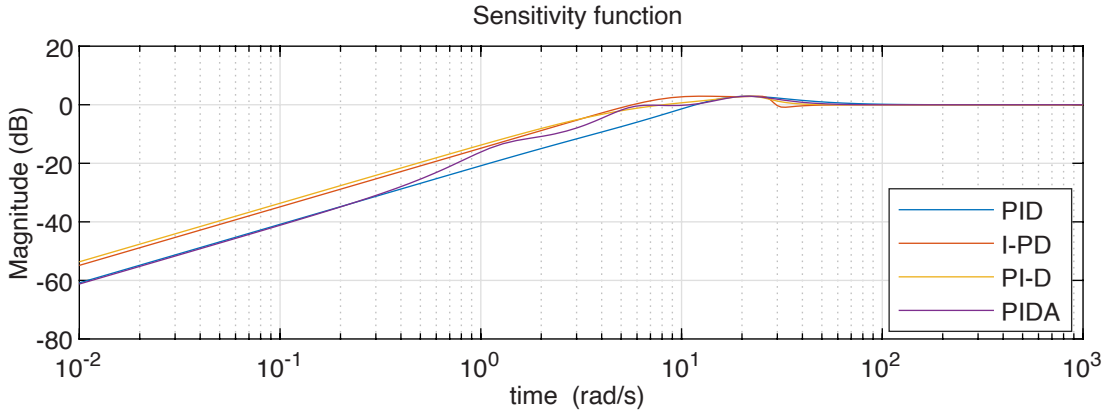


Parameters	PID	I-PD	PI-D	PIDA
Controller Transfer Function	$C(s) = \frac{5.711\,s^2+28.23\,s+22.86}{0.003629\,s^2+1.232\,s}$	$C_1(s) = \frac{268.9}{s}$ $C_2(s) = \frac{4.6\,s+50.18}{0.01049\,s+1.0}$	$C_1(s) = 22.4765$ $C_2(s) = \frac{0.642}{s}$ $C_3(s) = \frac{2.532\,s}{0.0115\,s+1.0}$	$C(s) = \frac{0.005784\,s^4+0.08837\,s^3+4.211\,s^2+10.02\,s+113.3}{1.434e{-}10\,s^4+8.878e{-}7\,s^3+0.001381\,s^2+0.02026\,s}$
IAE	0,090141691	0,213969334	0,16735641	0,01922498
K_p	22,8597525	50,18213303	22,47647036	113,2919294
T_i	1,232132127	0,186607043	3,719916019	0,020255545
T_d	0,199818343	0,081175763	0,112659936	1,764484793
T_a				0,03732237
N	67,84772677	7,737884459	9,797320012	26,12952349
α				115,2779358
PM	45.6194	60.3818	67.1716	26.0125
GM	4.8073	2.5265	3.2852	3.8277
MS	1.7898	1.9666	2.0192	1.8866



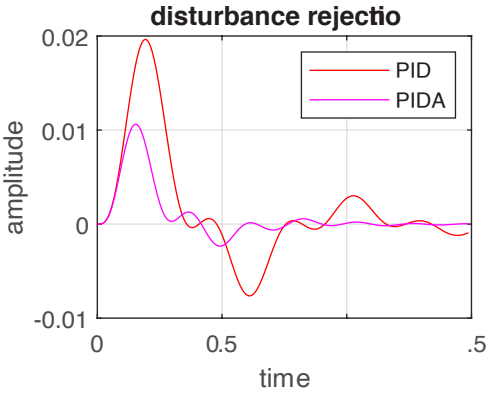


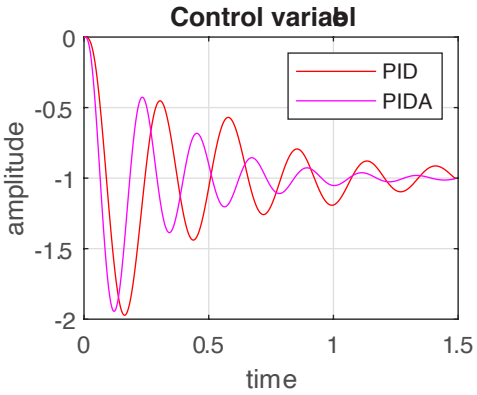


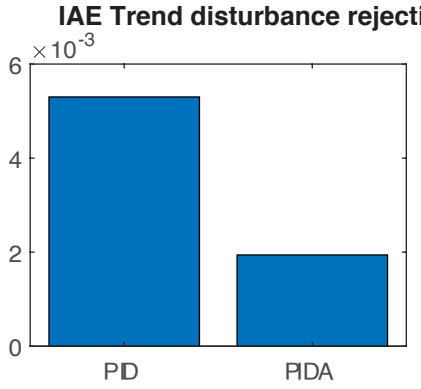


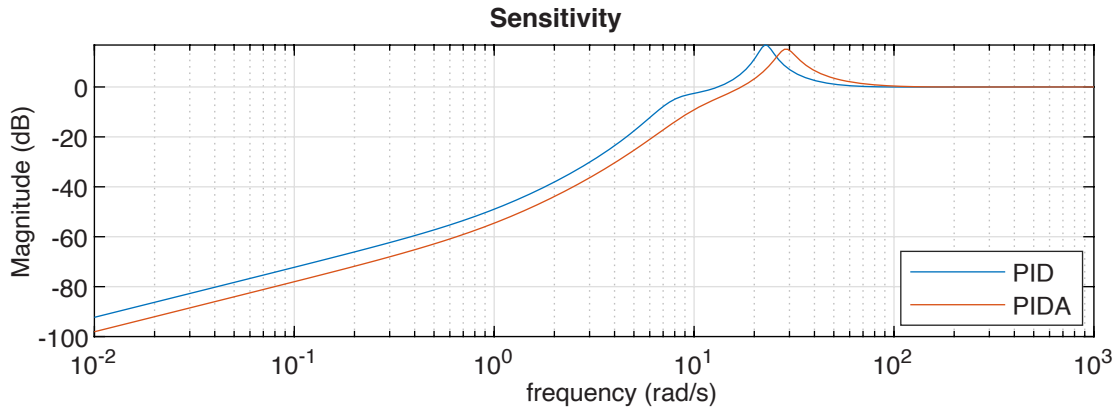
Parameters	PID	I-PD	PI-D	PIDA
Controller Transfer Function	$C(s) = \frac{3.109\ s^2+16.34\ s+13.41}{0.002269\ s^2+1.217\ s}$	$C_1(s) = \frac{568.2}{s}$ $C_2(s) = \frac{8.028\ s+101.6}{0.002031\ s+1.0}$	$C_1(s) = 29.0998$ $C_2(s) = \frac{4.811}{s}$ $C_3(s) = \frac{4.836\ s}{0.0065\ s+1.0}$	$C(s) = \frac{0.04333\ s^4+0.3585\ s^3+2.926\ s^2+4.076\ s+4.227}{0.0005316\ s^4+0.0206\ s^3+0.219\ s^2+0.3664\ s}$
IAE	0,100864593	0,199256492	0,207925127	0,230674932
K_p	13,40909392	101,5603986	29,09979951	4,227458931
T_i	1,216940084	0,178731833	6,049124527	0,366375385
T_d	0,1886735	0,077015531	0,166194957	1,137629926
T_a				0,047351501
N	101,2098371	37,91485538	25,56731626	2,327043517
α				0,869195614
MS	1,399253493	1,399944687	1,399949825	1,399953082
GM	9,586429873	3,593582716	3,830296371	4,929488472
PM	62,47282173	63,92892849	79,25411704	64,86950704

Disturbance Rejection Optimization

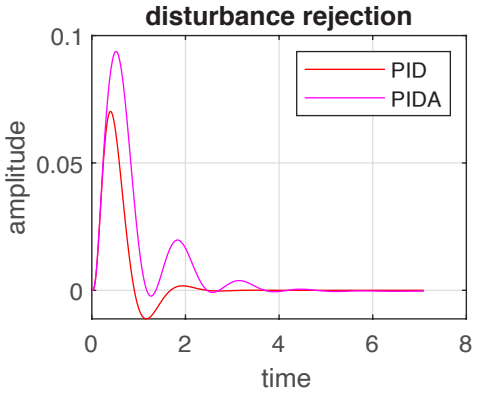


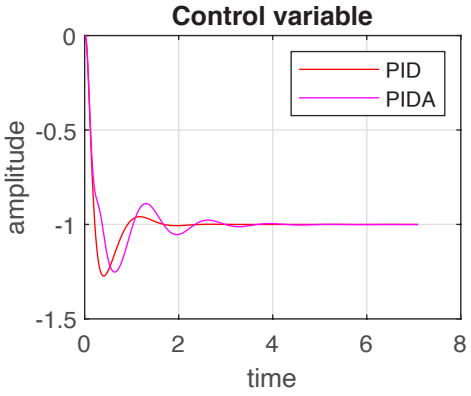


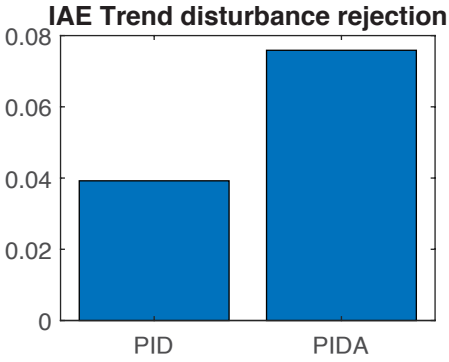


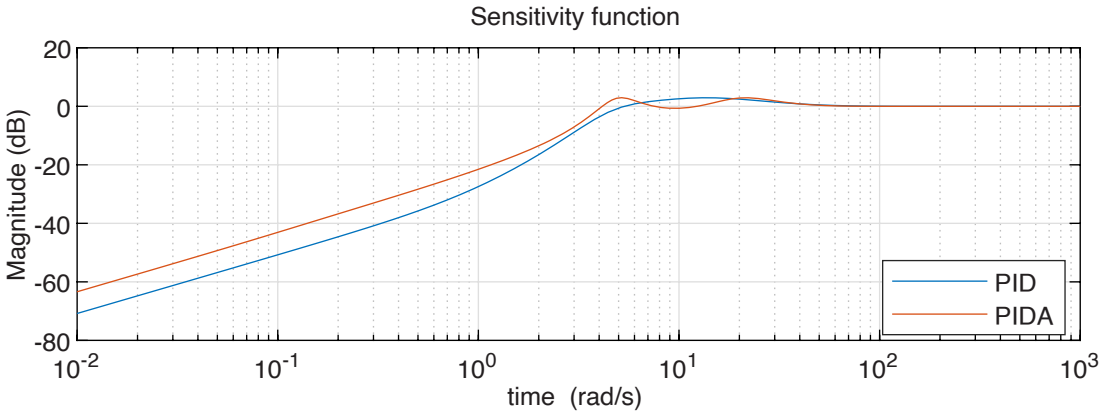


Parameters	PID_DIST	PIDA_DIST
Controller Transfer Function	$C(s) = \frac{0.5918\,s^2+3.58\,s+33.79}{0.001965\,s^2+0.08203\,s}$	$C(s) = \frac{5.406\,s^4+59.74\,s^3+506.4\,s^2+293.2\,s+43.22}{0.003143\,s^4+0.6123\,s^3+0.3633\,s^2+0.05397\,s}$
IAE	0,005300332	0,001939885
K_p	33,78506083	43,21660761
T_i	0,082025767	0,053968666
T_d	0,189608142	0,194356062
T_a		11,88333199
N	7,916021369	37,73960532
α		3,533482712
MS	6,9613	5,7631
GM	10.3317	1.5854
PM	1.3149	11.1280







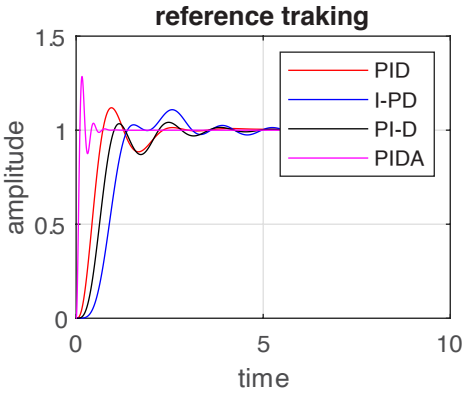


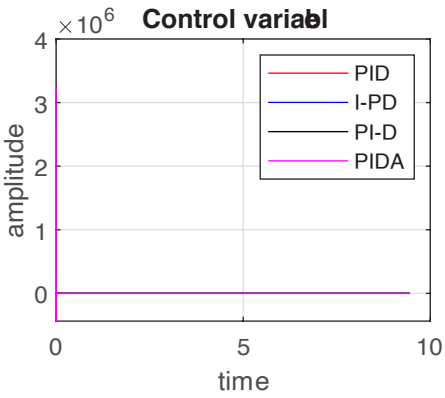
Parameters	PID_DIST	PIDA_DIST
Controller Transfer Function	$C(s) = \frac{0.4908\ s^2+3.482\ s+10.82}{0.003067\ s^2+0.3119\ s}$	$C(s) = \frac{0.3721\ s^4+1.997\ s^3+18.96\ s^2+21.85\ s+2.59}{0.004683\ s^4+0.1642\ s^3+1.449\ s^2+0.1754\ s}$
IAE	0,039225803	0,075875023
K_p	10,82196436	2,590408749
T_i	0,311878421	0,175446791
T_d	0,135593232	28,11739567
T_a		0,085927882
N	13,78647231	3,452341338
α		1,501003748
MS	1,399984663	1,399906791
GM	8,206139179	4,899569634
PM	49,3843387	42,32286023

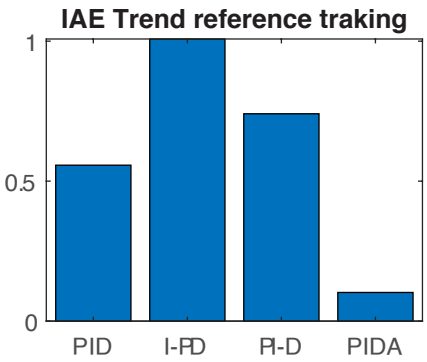
Fourth Order System 0,5

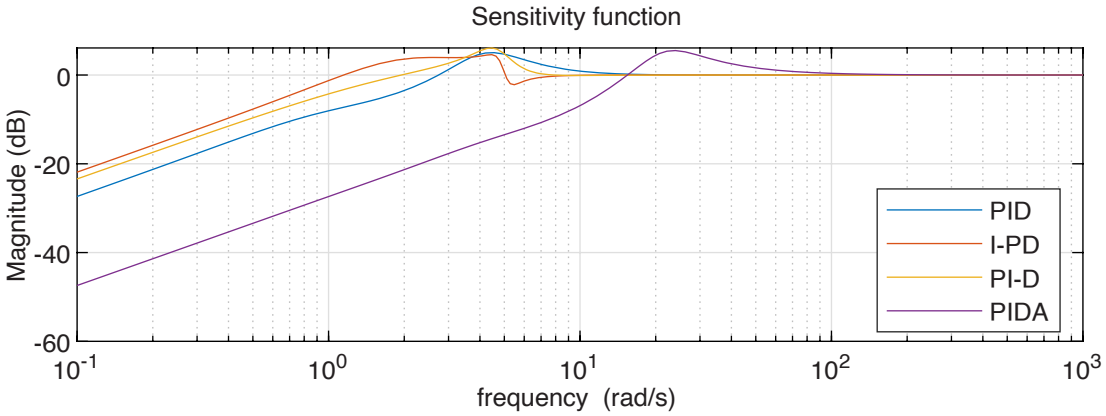
$$G(s) = \frac{1}{(s+1)(0.5s+1)(0.5^2 s+1)(0.5^3 s+1)}$$

Set Point Optimization

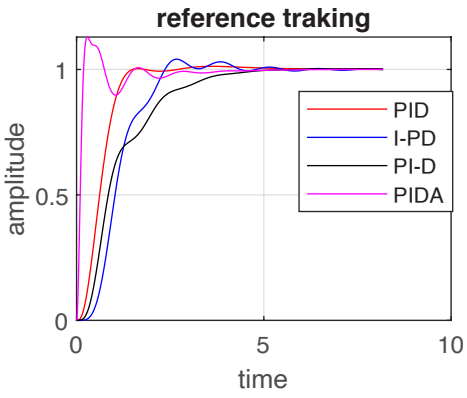


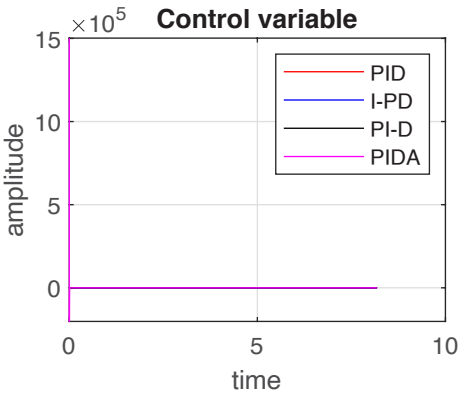


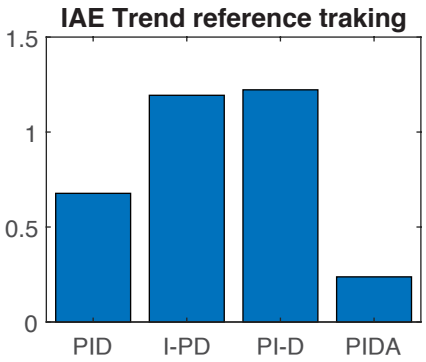


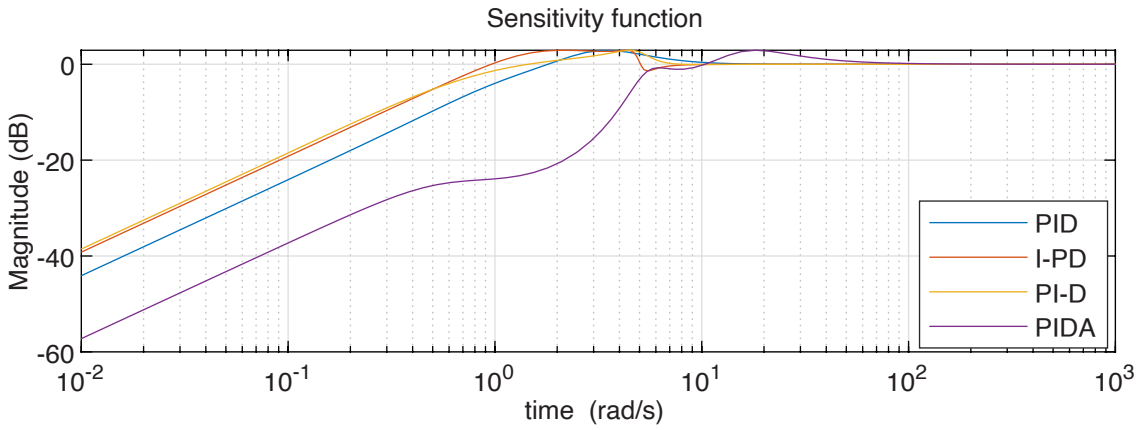


Parameters	PID	I-PD	PI-D	PIDA
Controller Transfer Function	$C(s) = \frac{3.927\,s^2+6.454\,s+3.878}{0.01036\,s^2+1.658\,s}$	$C_1(s) = \frac{15.73}{s}$ $C_2(s) = \frac{4.445\,s+11.65}{0.003349\,s+1.0}$	$C_1(s) = 7.3456$ $C_2(s) = \frac{1.479}{s}$ $C_3(s) = \frac{3.3\,s}{0.005687\,s+1.0}$	$C(s) = \frac{1.313\,s^4+12.83\,s^3+52.37\,s^2+82.98\,s+42.92}{4.069e{-}7\,s^4+0.0005589\,s^3+0.1946\,s^2+1.827\,s}$
IAE	0,556963947	1,007776069	0,740648676	0,102336199
K_p	3,877863325	11,65453682	7,345628173	42,92158184
T_i	1,658182838	0,740944082	4,966666789	1,82685303
T_d	0,604496033	0,378006417	0,449203128	0,561198571
T_a				0,16162016
N	96,71684994	112,8721567	78,98547945	5,417692611
α				110,2187621
PM	53,2646	57,5999	70,4567	71,1293
GM	3,7159	2,6375	2,0255	11,7038
MS	1.7898	1.6966	2.0192	1.8876



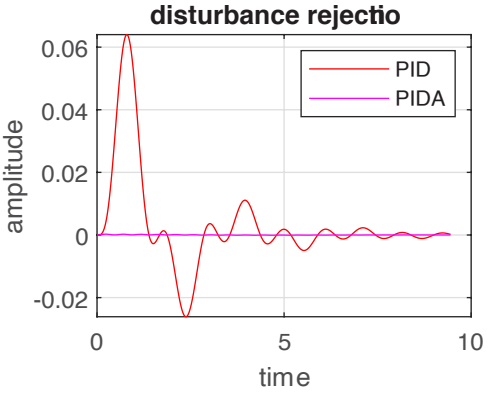


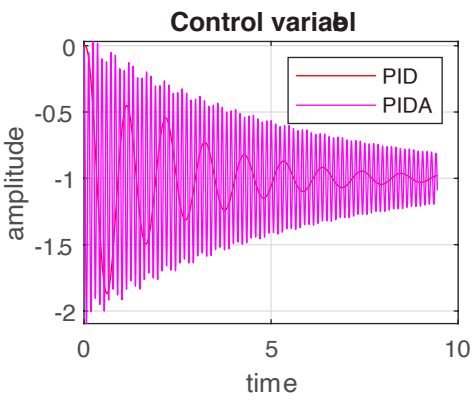


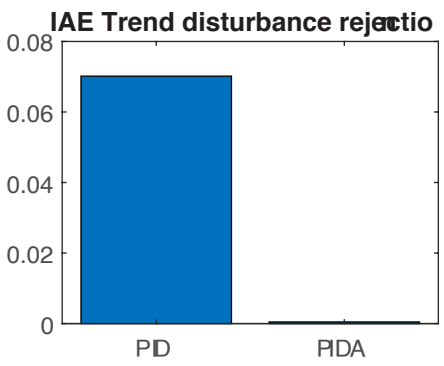


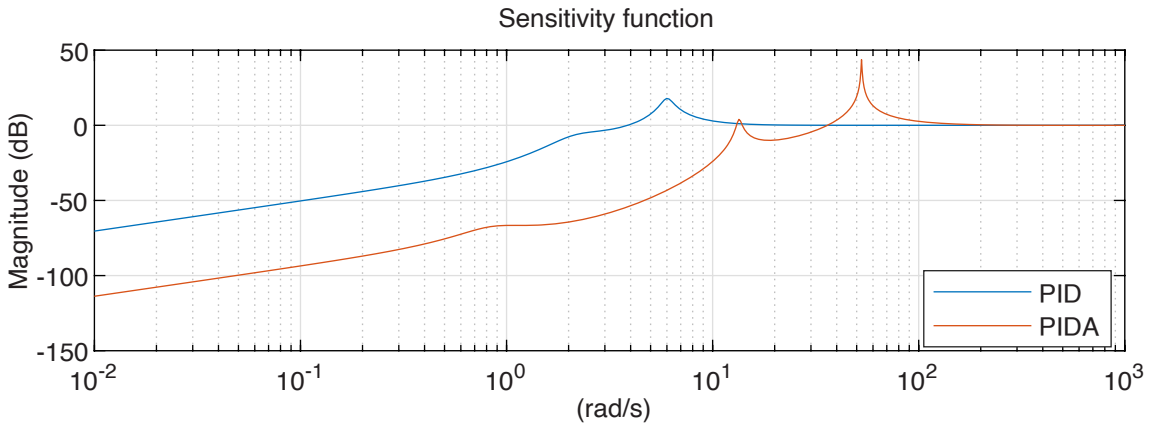
Parameters	PID	I-PD	PI-D	PIDA
Controller Transfer Function	$C(s) = \frac{1.677\ s^2+3.6\ s+2.4}{0.005724\ s^2+1.496\ s}$	$C_1(s) = \frac{11.02}{s}$ $C_2(s) = \frac{4.375\ s+11.1}{0.003865\ s+1.0}$	$C_1(s) = 4.206$ $C_2(s) = \frac{0.8459}{s}$ $C_3(s) = \frac{3.501\ s}{0.007306\ s+1.0}$	$C(s) = \frac{1.731\ s^4+8.652\ s^3+70.16\ s^2+59.92\ s+20.14}{1.152e{-}6\ s^4+0.001621\ s^3+0.5744\ s^2+2.767\ s}$
IAE	0,677299224	1,193470704	1,222300389	0,237633541
K_p	2,400114718	11,09930197	4,206028378	20,1445739
T_i	1,496099209	1,007395346	4,972452069	2,767033628
T_d	0,463220638	0,390299007	0,832419744	1,050825365
T_a				0,15163751
N	121,0774765	100,9923336	113,9302986	5,132980705
α				106,3240869
MS	1,399999728	1,399911552	1,399998385	1,399997174
GM	6,930150916	3,712158115	3,581755616	27,372079
PM	69,25501852	64,7012215	79,98950214	66,02665084

Disturbance Rejection Optimization

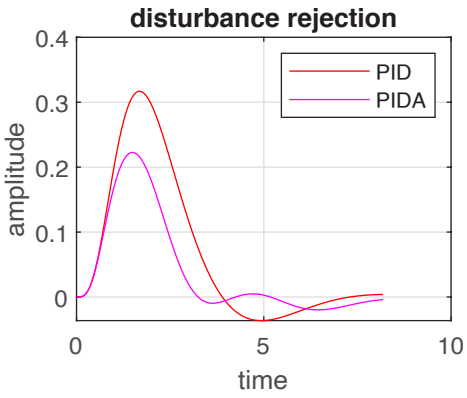


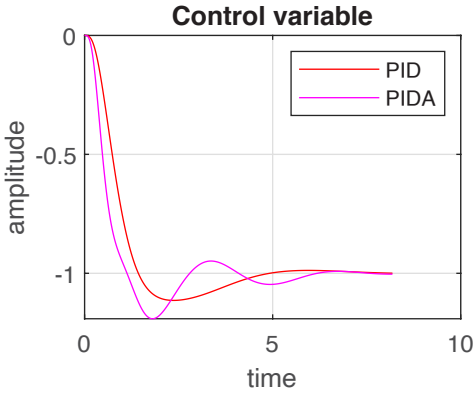


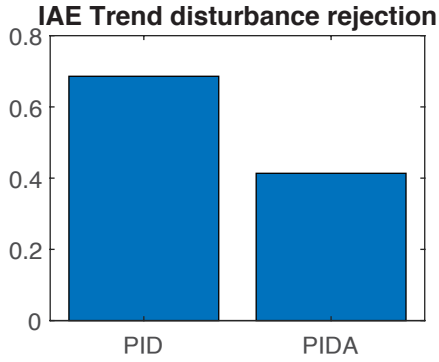


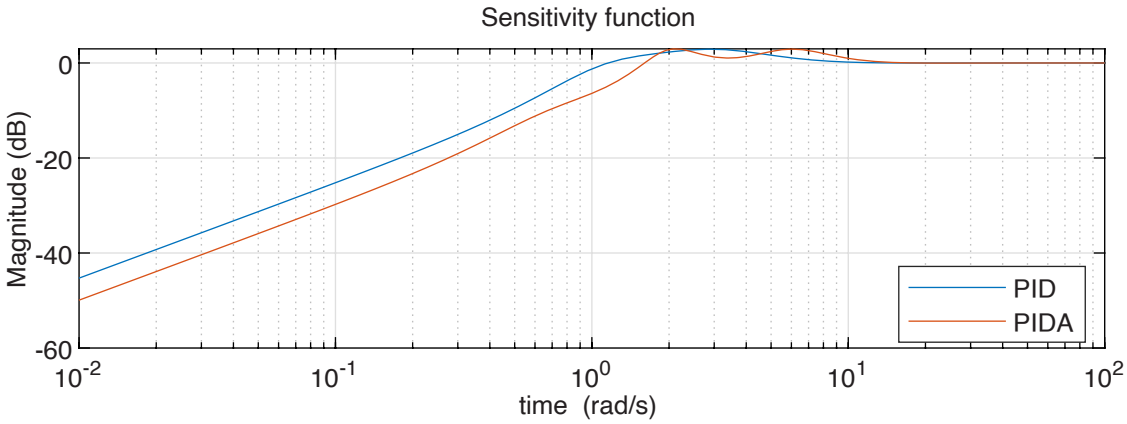


Parameters	PID_DIST	PIDA_DIST
Controller Transfer Function	$C(s) = \frac{2.634\,s^2+4.272\,s+11.84}{0.001139\,s^2+0.3576\,s}$	$C(s) = \frac{1.322\,s^4+2.737\,s^3+230.6\,s^2+141.0\,s+163.7}{1.674e{-}7\,s^4+0.0001362\,s^3+0.02779\,s^2+0.03357\,s}$
IAE	0,070159173	0,000456429
K_p	11,84053191	163,669812
T_i	0,35758603	0,033569875
T_d	0,618864133	41,03048759
T_a		0,291992882
N	194,2353525	49,86114744
α		118,6037727
Phase margin	1.2995	8.8706
Gain Margin	[0.0012 0.5909 1.0251]	0.3952
MS	7,8553	152,4376









Parameters	PID_DIST	PIDA_DIST
Controller Transfer Function	$C(s) = \frac{0.9108\,s^2+1.916\,s+1.826}{0.05635\,s^2+0.9929\,s}$	$C(s) = \frac{0.5452\,s^4+1.513\,s^3+5.381\,s^2+4.592\,s+2.253}{0.01027\,s^4+0.1888\,s^3+0.9478\,s^2+0.7185\,s}$
IAE	0,685978773	0,413579351
K_p	1,825616218	2,253338555
T_i	0,992891661	0,71852785
T_d	0,445736684	1,638845644
T_a		0,276059418
N	7,853323329	1,503452394
α		2,410228607
MS	1,39686737	1,399780537
GM	5,713826114	4,273371966
PM	56,97000397	46,90646538