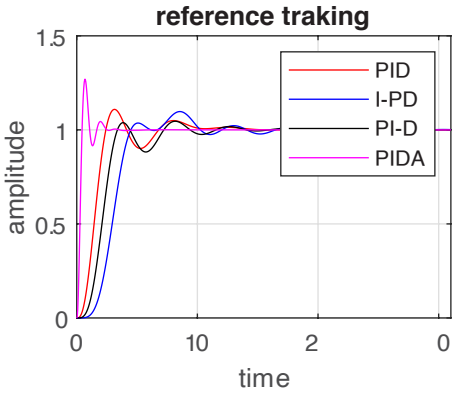
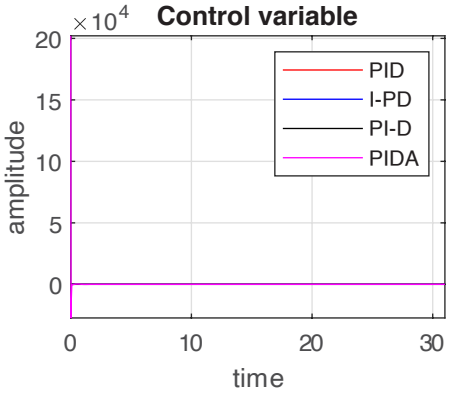
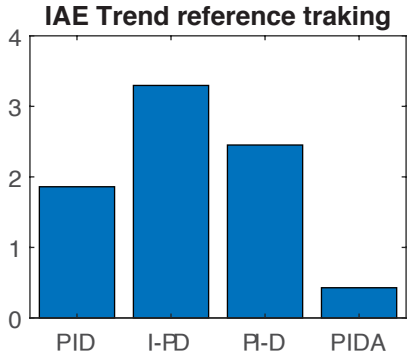
Multiple Equal Poles 4

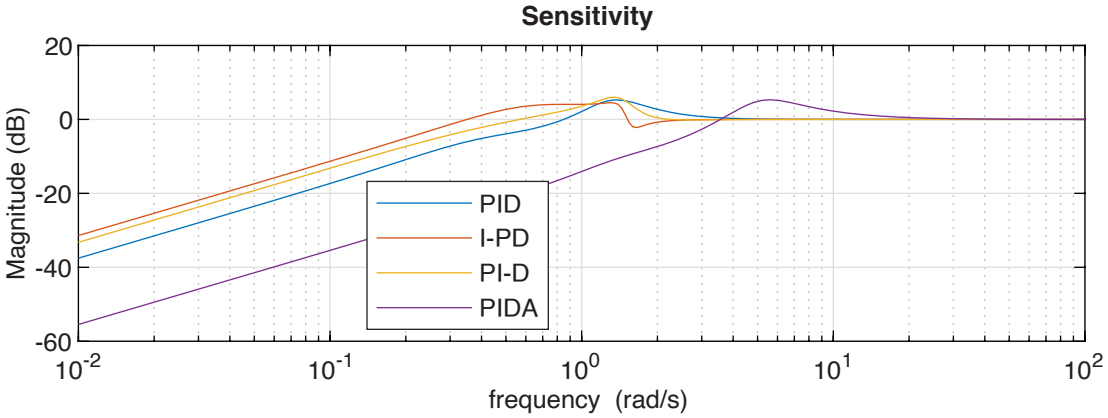
$$G(s) = \frac{1}{(1+s)^4}$$

Set Point Optimization

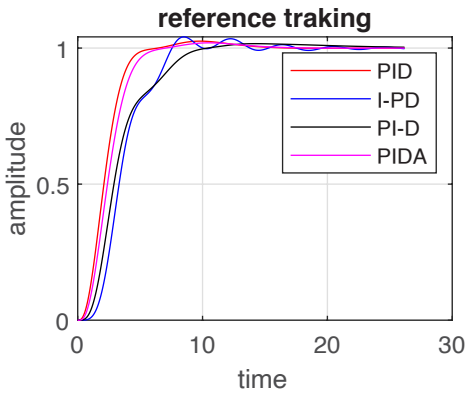


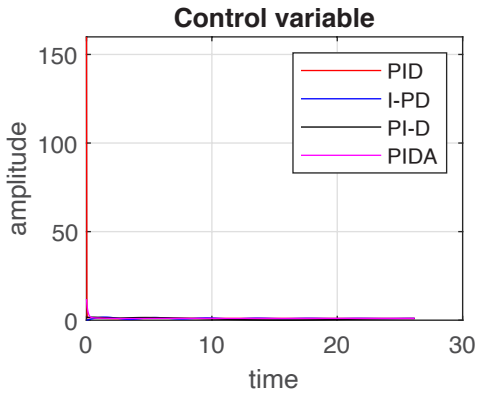


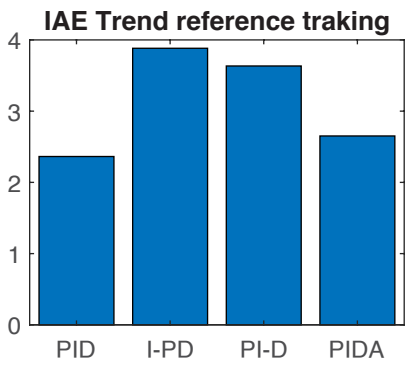


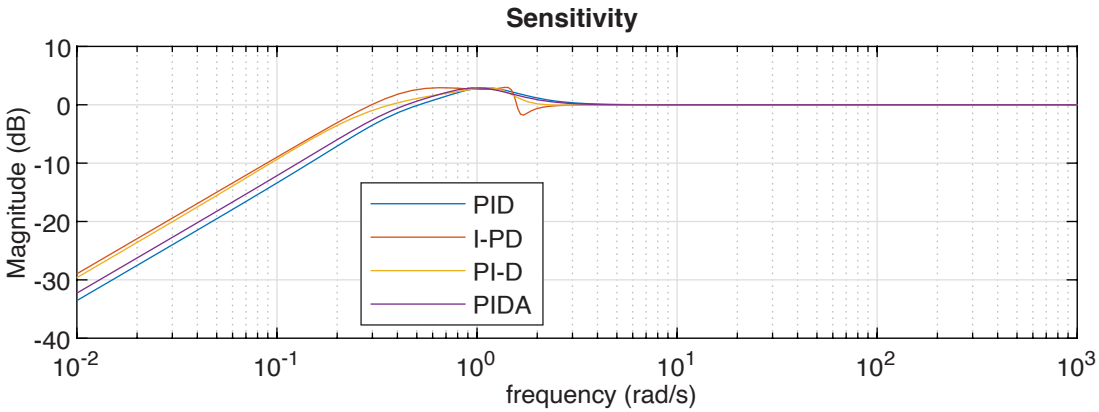


Parameters	PID	I-PD	PI-D	PIDA
Controller Transfer Function	$C(s) = \frac{9.976\,s^2+6.582\,s+2.221}{0.03694\,s^2+2.951\,s}$	$C_1(s) = \frac{2.266}{s}$ $C_2(s) = \frac{5.8\,s+5.096}{0.01114\,s+1.0}$	$C_1(s) = 3.3523$ $C_2(s) = \frac{0.4593}{s}$ $C_3(s) = \frac{4.288\,s}{0.01136\,s+1.0}$	$C(s) = \frac{33.26\,s^4+92.11\,s^3+135.7\,s^2+85.86\,s+21.42}{0.0001646\,s^4+0.03023\,s^3+1.428\,s^2+3.614\,s}$
IAE	1,86019015	3,29662604	2,45194072	0,428337809
K_p	2,22139715	5,09621614	3,35230048	21,41667326
T_i	2,95058497	2,2491231	7,29901657	3,614138354
T_d	1,50957956	1,12701755	1,27919531	1,355353477
T_a				1,151688993
N	120,579985	101,174203	112,581389	3,633894232
α				104,2221126
PM	59.1530	58.1288	69.3678	40.5777
GM	3.2491	2.5994	2.0305	7.5223
MS	1.8380	1.6839	2.0022	1.8440



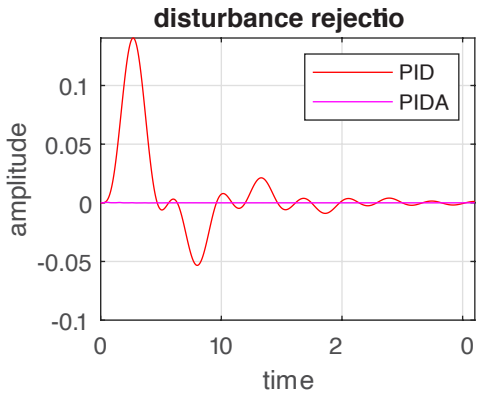


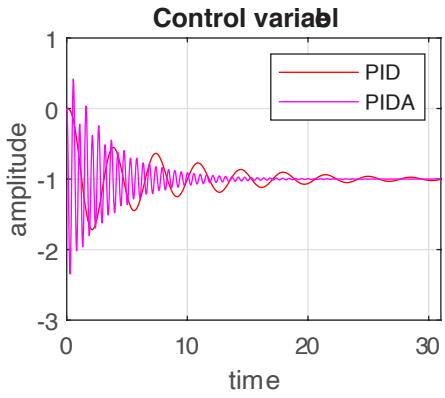


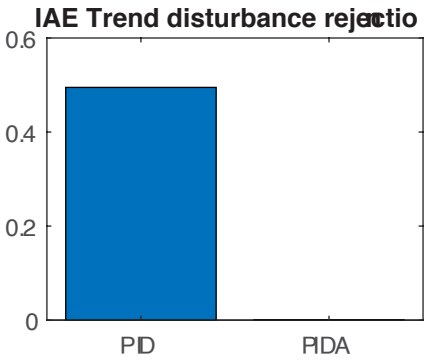


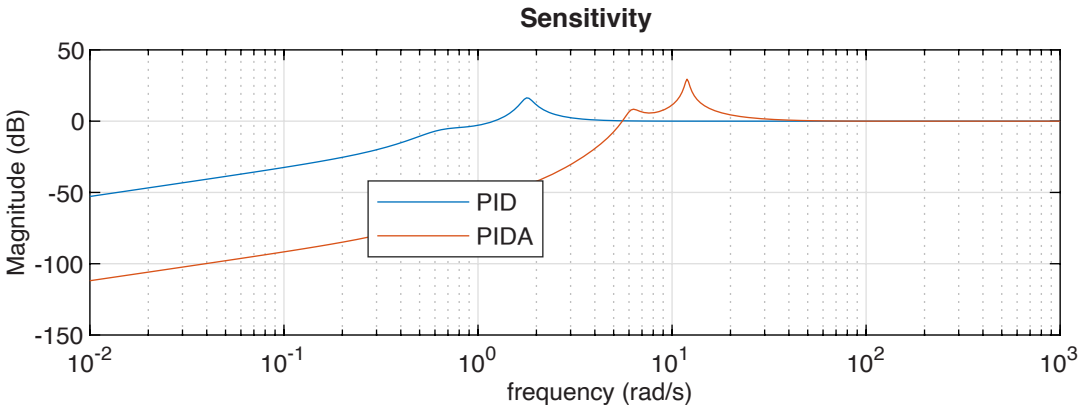
Parameters	PID	I-PD	PI-D	PIDA
Controller Transfer Function	$C(s) = \frac{4.295\ s^2+3.599\ s+1.307}{0.02686\ s^2+2.745\ s}$	$C_1(s) = \frac{1.76}{s}$ $C_2(s) = \frac{6.394\ s+5.272}{0.01167\ s+1.0}$	$C_1(s) = 1.6201$ $C_2(s) = \frac{0.303}{s}$ $C_3(s) = \frac{3.124\ s}{0.01661\ s+1.0}$	$C(s) = \frac{2246.0\ s^4+2179.0\ s^3+867.6\ s^2+59.05\ s+1.107}{188.4\ s^4+1737.0\ s^3+136.5\ s^2+2.694\ s}$
IAE	2,363190837	3,882673858	3,634058167	2,651505146
K_p	1,306597898	5,271800045	1,620103707	1,106551087
T_i	2,745029098	2,995048768	5,346954735	2,693966519
T_d	1,187732508	1,201107627	1,928284961	1,06806565
T_a				6,265007641
N	121,3961129	102,8997575	116,0620009	9,762698863
α				0,247807837
MS	1,399999999	1,399999939	1,399979185	1,399999984
GM	5,909554907	3,772076669	3,688358708	5,336471963
PM	68,57693052	64,85172446	72,27092173	67,86780564

Disturbance Rejection Optimization

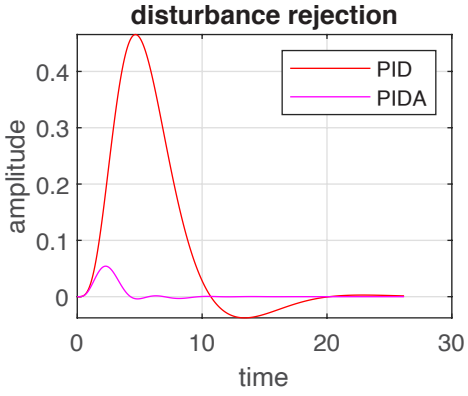


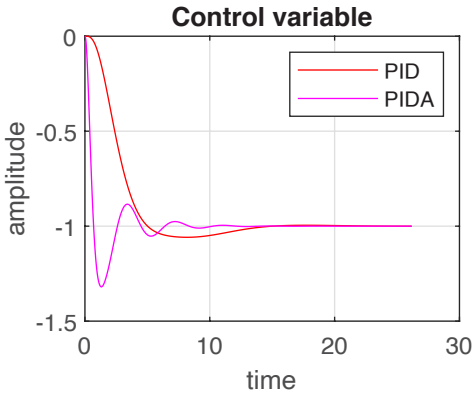


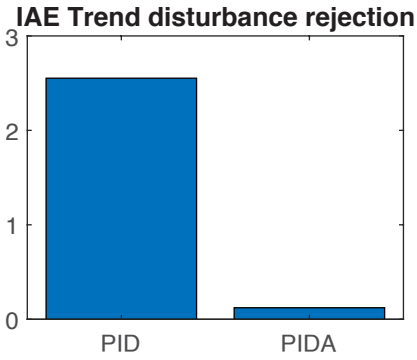


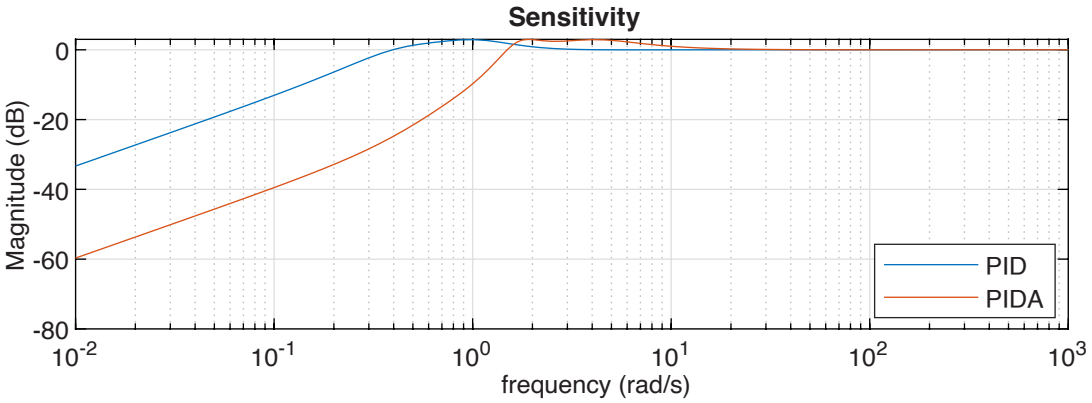


Parameters	PID	PIDA
Controller Transfer Function	$C(s) = \frac{11.64\,s^2+6.134\,s+5.171}{0.007024\,s^2+1.18\,s}$	$C(s) = \frac{6.379\,s^4+13.59\,s^3+209.5\,s^2+150.6\,s+208.5}{2.914e{-}6\,s^4+0.0006374\,s^3+0.03534\,s^2+0.05279\,s}$
IAE	0,49493553	0,000591112
K_p	5,17118574	208,5087277
T_i	1,180252291	0,052788404
T_d	1,901289735	18,13698334
T_a		0,887788038
N	319,4559054	27,8580706
α		96,41769598
PM	11.2392	2.0049
GM	1.3320	1.1406
MS	6.6096	29.7076







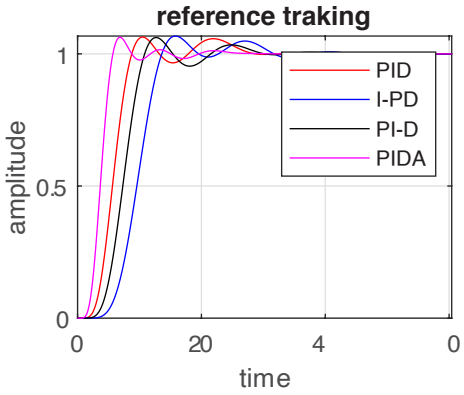


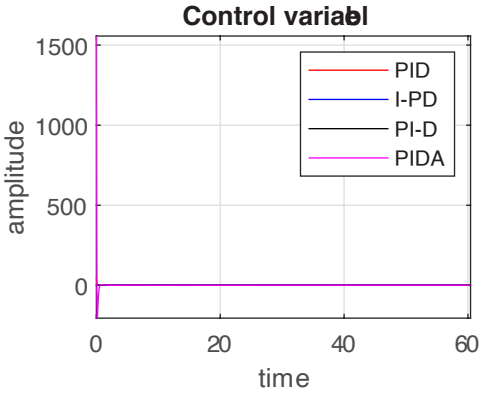
Parameters	PID	PIDA
Controller Transfer Function	$C(s) = \frac{3.093\ s^2+2.589\ s+1.063}{0.3273\ s^2+2.293\ s}$	$C(s) = \frac{8.761\ s^4+24.36\ s^3+53.1\ s^2+43.17\ s+18.64}{4.125e{-}5\ s^4+0.01099\ s^3+0.7462\ s^2+1.929\ s}$
IAE	2,552064079	0,121810568
K_p	1,063198302	18,63790073
T_i	2,292760653	1,929180733
T_d	1,126036849	1,086980199
T_a		0,655352933
N	7,887304884	2,924734451
α		86,40449412
MS	1,399999756	1,399999816
GM	5,177292475	21,89355123
PM	61,37945495	41,84988235

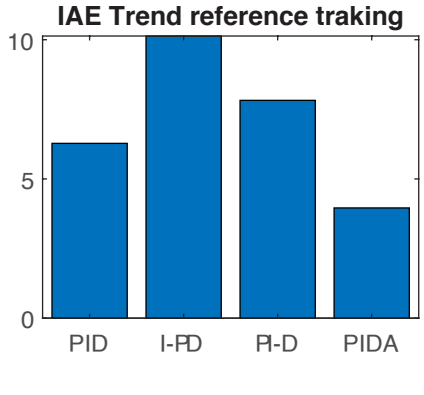
Multiple Equal Poles 8

$$G(s) = \frac{1}{(1+s)^8}$$

Set Point Optimization

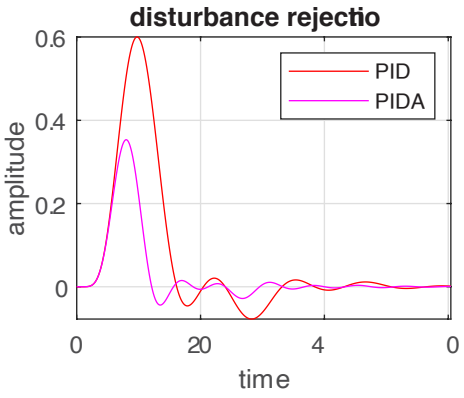


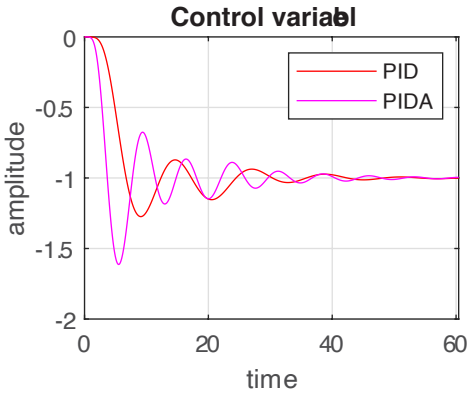


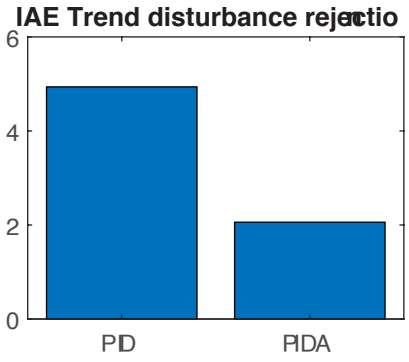


Parameters	PID	I-PD	PI-D	PIDA
Controller Transfer Function	$C(s) = \frac{10.34\,s^2+4.159\,s+0.8897}{0.1959\,s^2+4.633\,s}$	$C_1(s) = \frac{0.2517}{s}$ $C_2(s) = \frac{2.868\,s+1.269}{0.05096\,s+1.0}$	$C_1(s) = 0.9033$ $C_2(s) = \frac{0.1421}{s}$ $C_3(s) = \frac{2.057\,s}{0.04759\,s+1.0}$	$C(s) = \frac{62.38\,s^4+62.22\,s^3+42.17\,s^2+12.88\,s+1.737}{0.04008\,s^4+1.082\,s^3+7.771\,s^2+6.152\,s}$
IAE	6,277880471	10,1330807	7,82244652	3,95844953
K_p	0,889669486	1,26876863	0,903271164	1,73724034
T_i	4,632952243	5,0401914	6,358526489	6,15158044
T_d	2,467196892	2,20925055	2,277713359	2,6542542
T_a				5,2385362
N	58,35629582	43,3525888	47,86127125	2,3910478
α				68,3786343
Phase margin	61.7235	59.4700	62.3123	61.6754
Gain Margin	2.1815	2.3218	2.1347	2.2461

Disturbance Rejection Optimization







	Controllers	
Parameters	PID	PIDA
Controller Transfer Function	$C(s) = \frac{14.55\,s^2+5.024\,s+1.156}{0.114\,s^2+4.32\,s}$	$C(s) = \frac{125.2\,s^4+101.4\,s^3+76.86\,s^2+21.81\,s+3.285}{0.008846\,s^4+0.4994\,s^3+7.237\,s^2+5.262\,s}$
IAE	4,937284438	2,058846387
K_p	1,155896791	3,285265538
T_i	4,320107233	5,262435143
T_d	2,887487826	3,052290444
T_a		5,552289657
N	109,4362925	2,34181803
α		154,603634
Phase margin	57.5868	32.5744
Gain Margin	1.5883	1.2977