Multiple Equal Poles

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

Set Point Optimization

	Controllers			
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
Phase margin	59.1530	58.1288	69.3678	40.5777

	Controllers			
Gain Margin	3.2491	2.5994	2.0305	7.5223

Disturbance Rejection Optimization

	Controllers	
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
Phase margin	11.2392	2.0049
Gain Margin	1.3320	1.1406

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

Set Point Optimization

	Controllers			
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	$C(s) = \frac{14.55\,s^2+5.024\,s+1.156}{0.114\,s^2+4.32\,s}$	$C(s) = \frac{125.2\,s^4+101.4\,s^3+76.86\,s^2+21.81\,s+3.285}{0.008846\,s^4+0.4994\,s^3+7.237\,s^2+5.262\,s}$
parametri	PID_DIST	PIDA_DIST
---	---	---
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