Fourth Order System

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

Set Point Optimization

	Controllers			
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
Phase margin	45.6194	60.3818	67.1716	26.0125
Gain Margin	4.8073	2.5265	3.2852	3.8277

Disturbance Rejection Optimization

	Controllers	
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
Phase margin	10.3317	1.5854
Gain Margin	1.3149	11.1280

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

Set Point Optimization

	Controllers			
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
Phase margin	53,2646	57,5999	70,4567	71,1293
Gain Margin	3,7159	2,6375	2,0255	11,7038

Disturbance Rejection Optimization

	Controllers	
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