

Adaptive Regulation via Weighted Robust Estimation and Automatic Controller Tuning

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I. SIMULATION RESULTS

TABLE I
SIMULATION RESULTS - SIMPLE STEP TEST

LEVEL 1							
Frequency (Hz)	GA (dB)	DA (dB)	MA (dB@Hz)	N ² T ($\times 10^{-3}$)	N ² R ($\times 10^{-3}$)	MV ($\times 10^{-3}$)	TD (ratio)
50	33.6	41.0	4.3@67.2	22.1	4.0	19.3	1.04
55	33.2	37.7	4.5@71.9	21.8	4.2	21.6	1.04
60	32.9	35.8	4.4@46.9	20.6	4.4	21.2	1.03
65	33.1	34.7	4.6@112.5	17.2	4.4	18.3	1.02
70	33.3	34.1	4.5@31.3	12.4	4.3	19.1	1.02
75	33.8	33.6	4.4@31.3	10.9	4.2	20.0	1.02
80	34.0	33.1	4.7@104.7	14.4	4.0	21.5	1.04
85	33.8	32.5	4.6@109.4	21.7	4.0	23.7	1.05
90	31.7	30.9	5.3@112.5	25.1	4.2	27.5	1.03
95	23.1	25.2	6.4@129.7	19.5	5.0	32.0	1.01
LEVEL 2							
Frequency (Hz)	GA (dB)	DA (dB)-(dB)	MA (dB@Hz)	N ² T ($\times 10^{-3}$)	N ² R ($\times 10^{-3}$)	MV ($\times 10^{-3}$)	TD (ratio)
50-70	38.5	39.2 - 33.1	6.1@31.3	37.5	4.6	26.4	1.00
55-75	38.4	36.8 - 32.7	6.2@129.7	37.8	4.7	31.3	1.00
60-80	38.3	34.5 - 32.1	7.2@48.4	40.1	4.7	35.4	1.03
65-85	37.8	33.6 - 31.3	8.7@104.7	60.5	5.0	38.1	1.02
70-90	37.1	33.5 - 30.1	7.3@109.4	45.8	5.0	40.2	1.00
75-95	33.2	32.7 - 23.9	8.7@103.1	38.4	5.9	44.3	0.99
LEVEL 3							
Frequency (Hz)	GA (dB)	DA (dB)-(dB)-(dB)	MA (dB@Hz)	N ² T ($\times 10^{-3}$)	N ² R ($\times 10^{-3}$)	MV ($\times 10^{-3}$)	TD (ratio)
50-65-80	36.1	26.4 - 22.5 - 27.2	13.4@104.7	79.1	9.1	46.3	1.04
55-70-85	36.9	29.9 - 25.2 - 28.9	11.5@104.7	93.8	8.3	51.9	0.97
60-75-90	33.8	26.9 - 22.0 - 25.1	12.6@112.5	95.9	11.2	55.6	0.98
65-80-95	29.1	21.8 - 20.2 - 14.9	14.2@114.1	97.0	16.1	58.6	0.98

TABLE II
SIMULATION RESULTS - CHIRP TEST

Profile	Mean Square $\times 10^{-6}$		Maximum $\times 10^{-3}$	
	↗	↘	↗	↘
Level 1	10.6	7.97	8.96	7.81
Level 2	9.41	8.74	10.3	8.89
Level 3	6.05	5.66	7.90	10.0

TABLE III
SIMULATION RESULTS - STEP FREQUENCY CHANGES TEST

	Frequency (Hz)	N ² T ($\times 10^{-3}$)	MV ($\times 10^{-3}$)
Level 1	Sequence - 1		
	60→70	13.7	17.6
	70→60	13.2	14.4
	60→50	21.7	16.1
	50→60	21.2	19.2
	Sequence - 2		
	75→85	16.2	15.1
	85→75	13.1	15.0
	75→65	14.1	13.9
	65→75	15.6	14.8
	Sequence - 3		
	85→95	12.2	17.9
	95→85	19.3	24.3
	85→75	14.0	15.9
75→85	12.7	14.7	
Level 2	Sequence - 1		
	[55-75]→[60-80]	13.8	18.9
	[60-80]→[55-75]	14.2	17.2
	[55-75]→[50-70]	19.1	17.7
	[50-70]→[55-75]	17.6	19.3
	Sequence - 2		
	[70-90]→[75-95]	16.2	20.6
	[75-95]→[70-90]	20.1	24.4
	[70-90]→[65-85]	15.2	19.2
	[65-85]→[70-90]	14.2	16.7
Level 3	Sequence - 1		
	[55-70-85]→[60-75-90]	23.1	19.3
	[60-75-90]→[55-70-85]	22.9	26.2
	[55-70-85]→[50-65-80]	29.7	23.0
	[50-65-80]→[55-70-85]	23.6	25.9
	Sequence - 2		
	[60-75-90]→[65-80-95]	36.0	29.4
	[65-80-95]→[60-75-90]	35.9	35.8
[60-75-90]→[55-70-85]	21.7	29.2	
[55-70-85]→[60-75-90]	24.1	21.7	

II. REAL TIME RESULTS

TABLE IV
REAL TIME RESULTS - SIMPLE STEP TEST

LEVEL 1							
Frequency (Hz)	GA (dB)	DA (dB)	MA (dB@Hz)	N ² T ($\times 10^{-3}$)	N ² R ($\times 10^{-3}$)	MV ($\times 10^{-3}$)	TD (ratio)
50	36.5	40.3	13.0@131.3	40.5	5.4	21.3	0.909
55	34.7	36.7	8.7@132.8	30.7	4.9	22.6	0.913
60	35.1	35.1	10.7@132.8	31.6	4.5	22.6	1.194
65	29.7	33.6	20.0@134.4	22.4	6.3	19.1	1.043
70	28.8	32.7	13.7@134.4	19.9	6.0	20.4	1.084
75	24.5	31.8	25.5@135.9	11.7	8.9	17.9	0.893
80	24.9	31.2	24.7@135.9	9.9	8.1	20.1	0.807
85	28.8	30.2	14.5@137.5	8.8	4.9	18.9	0.977
90	22.2	28.0	23.6@135.9	12.8	9.4	22.5	0.589
95	23.1	23.6	10.7@103.1	17.6	6.7	22.8	1.045
LEVEL 2							
Frequency (Hz)	GA (dB)	DA (dB)-(dB)	MA (dB@Hz)	N ² T ($\times 10^{-3}$)	N ² R ($\times 10^{-3}$)	MV ($\times 10^{-3}$)	TD (ratio)
50-70	37.0	36.4 - 31.4	11.1@90.6	70.0	8.0	36.0	1.067
55-75	34.8	35.5 - 30.6	16.3@132.8	47.2	8.0	30.1	1.065
60-80	33.7	33.7 - 29.7	17.8@134.4	41.8	8.0	28.9	0.851
65-85	28.3	29.0 - 26.6	14.6@132.8	61.3	13.2	31.2	0.719
70-90	27.1	30.1 - 24.3	21.3@103.1	42.0	13.5	34.8	0.804
75-95	23.1	29.7 - 19.8	24.6@132.8	51.5	19.3	36.1	0.631
LEVEL 3							
Frequency (Hz)	GA (dB)	DA (dB)-(dB)-(dB)	MA (dB@Hz)	N ² T ($\times 10^{-3}$)	N ² R ($\times 10^{-3}$)	MV ($\times 10^{-3}$)	TD (ratio)
50-65-80	24.0	27.2 - 7.8 - 24.5	21.9@103.1	160.3	47.7	41.0	1.575
55-70-85	21.6	24.9 - 7.7 - 19.8	21.0@103.1	119.4	52.0	43.5	0.808
60-75-90	13.8	25.9 - 3.1 - 20.0	22.8@132.8	164.4	115.7	57.0	1.103
65-80-95	15.7	23.5 - 12.1 - 4.7	24.3@137.5	150.2	82.8	53.3	1.071

TABLE V
REAL TIME RESULTS - CHIRP TEST

Profile	Mean Square $\times 10^{-6}$		Maximum $\times 10^{-3}$	
	↗	↘	↗	↘
Level 1	13.2	10.5	10.1	10.1
Level 2	15.6	15.1	14.9	12.5
Level 3	44.1	70.8	23.2	22.1

TABLE VI
REAL TIME RESULTS - STEP FREQUENCY CHANGES TEST

	Frequency (Hz)	N ² T ($\times 10^{-3}$)	MV ($\times 10^{-3}$)
Level 1	Sequence - 1		
	60→70	28.0	20.3
	70→60	22.6	17.9
	60→50	31.3	17.9
	50→60	22.6	23.8
	Sequence - 2		
	75→85	18.4	15.7
	85→75	23.4	16.2
	75→65	22.7	19.8
	65→75	32.3	16.9
	Sequence - 3		
	85→95	15.0	16.9
	95→85	24.9	19.9
	85→75	24.4	13.7
75→85	18.3	17.4	
Level 2	Sequence - 1		
	[55-75]→[60-80]	19.1	18.6
	[60-80]→[55-75]	21.6	18.6
	[55-75]→[50-70]	42.1	22.3
	[50-70]→[55-75]	47.3	26.7
	Sequence - 2		
	[70-90]→[75-95]	25.8	13.7
	[75-95]→[70-90]	34.9	20.6
	[70-90]→[65-85]	23.6	18.6
	[65-85]→[70-90]	33.2	18.6
Level 3	Sequence - 1		
	[55-70-85]→[60-75-90]	193.5	20.7
	[60-75-90]→[55-70-85]	109.2	25.9
	[55-70-85]→[50-65-80]	102.8	31.7
	[50-65-80]→[55-70-85]	162.4	21.0
	Sequence - 2		
	[60-75-90]→[65-80-95]	149.7	25.6
	[65-80-95]→[60-75-90]	229.2	25.6
[60-75-90]→[55-70-85]	110.9	27.1	
[55-70-85]→[60-75-90]	183.7	23.2	