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# Model Parameters

## 0.1 Models Identified to Approximate Systems A and B

It is important to note that the discretisation step size of these models is 1 second.

### 0.1.1 Model Parameters of Models Approximating System A

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.05540618850	-0.01350287933	-0.67977994584	-0.66261165389
$A_2$	0.36145144555	0.01152582209	-0.480671584105	0.21914276246
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	0.00824535052	-0.00897154910	0.42843696718	-0.13875198407
$B_2$	0.02766332279	0.00550953274	1.03591283249	1.12482710546

**Table 1:** Model parameters for the linear ARX model obtained from experiment OL 1

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-0.98803735585	-0.01339715658	0.87189300156	-0.56884905581
$A_2$	0.32557832900	0.01246544591	-1.23352869196	0.20667995323
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	0.00137498349	-0.00407464899	-0.056466380618	-0.05001750421
$B_2$	0.00976029726	-0.00632513248	0.40323968391	0.40384123462

**Table 2:** Model parameters for the linear ARX model obtained from experiment OL 2

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.04725363270	-0.01991174643	3.63872504485	-1.12231384235
$A_2$	0.30488686275	0.01837536135	-5.41880898503	0.58727066482
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.04507952931	0.00175120057	-1.68128605887	-1.20257462913
$B_2$	0.11172667138	-0.00999264889	4.14518594857	3.17228632894

**Table 3:** Model parameters for the linear ARX model obtained from experiment OL 3

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.11618977808	-0.01678707218	1.74331094047	-1.05829562657
$A_2$	0.34867654023	0.01419167518	-2.69228563106	0.44167155386
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.02476003502	0.01114333986	-0.78795193771	-0.28051263685
$B_2$	0.11621952787	-0.02309544480	3.85644953305	2.72964955942

**Table 4:** Model parameters for the linear ARX model obtained from experiment OL 4

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	0.05523177779	-0.03543249650	-0.58945493244	-0.99350050417
$A_2$	0.00475310885	-0.00041287532	-1.92754636587	0.41326721907
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	0.01797593532	0.01797593532	1.42823790120	1.42823790120
$B_2$	0.01797593532	0.01797593532	1.42823790120	1.42823790120

**Table 5:** Model parameters for the linear ARX model obtained from experiment OL 5

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-0.35492725283	-0.03205333056	-0.76767349350	-1.01888022414
$A_2$	-0.21124380817	0.01902878664	0.46639025457	0.36494806209
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.03797338165	-0.01257285935	-0.21203542351	0.01356643406
$B_2$	0.17540547059	-0.0781157085	3.52057257027	2.50370104312

**Table 6:** Model parameters for the linear ARX model obtained from experiment CL 1

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-0.29158542253	-0.03308850631	0.78558247897	-1.05570683351
$A_2$	-0.27146854979	0.01918839699	-0.704484451347	0.36967441771
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	0.01540798511	-0.01129893304	0.04951126814	0.27016980585
$B_2$	0.11671001706	-0.08472506853	3.22952289179	2.05624642341

**Table 7:** Model parameters for the linear ARX model obtained from experiment CL 2

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-0.37481553195	-0.03406319568	0.07543412214	-0.97765987478
$A_2$	-0.18062615515	0.02019540197	-0.50759865194	0.34537199610
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.04408712203	0.04229286782	-0.83604824191	-0.80961473621
$B_2$	0.18641803658	-0.13455876988	4.30101531358	3.49670506002

**Table 8:** Model parameters for the linear ARX model obtained from experiment CL 3

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-0.36241828238	-0.03558465153	0.16092107278	-0.98040994093
$A_2$	-0.18255538514	0.02075544302	-0.57501455813	0.34817187889
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.05833634116	0.03913103449	-1.06599691533	-0.87318248954
$B_2$	0.19969780541	-0.13669599174	4.57456384942	3.58232873383

**Table 9:** Model parameters for the linear ARX model obtained from experiment CL 4

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-0.31737645559	-0.03778810386	0.15511207256	-0.99037923461
$A_2$	-0.19456718004	0.02031090071	-0.68134176748	0.35762777170
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.03329086741	0.05859050629	-0.80372217829	-1.01426549559
$B_2$	0.16837378551	-0.17454838483	4.20347753086	3.69426106453

**Table 10:** Model parameters for the linear ARX model obtained from experiment CL 5

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-0.35597078532	-0.03394470302	-0.06706438060	-0.96533891454
$A_2$	-0.18155993015	0.02070207998	-0.17423175403	0.34938782342
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.08064033406	0.04238127740	-1.27576423589	-0.95363698793
$B_2$	0.23127994614	-0.13640923209	4.79012484624	3.59425592527

**Table 11:** Model parameters for the linear ARX model obtained from experiment CL 6

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-0.21388974368	-0.04312707303	-0.20714040318	-1.00281235174
$A_2$	-0.26472603850	0.0245876209	-0.39490587534	0.35331703669
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.02477733288	0.06542217177	-0.05365451593	-0.59412680517
$B_2$	0.16409569229	-0.19334911713	3.26198783686	3.16929229716

**Table 12:** Model parameters for the linear ARX model obtained from experiment CL 7

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-0.18274773057	-0.0438467930	-0.14737253859	-0.98326358916
$A_2$	-0.26440975071	0.02509333961	-0.60550551843	0.34470357206
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.04530406143	0.07985957392	0.13037431809	-0.83325340885
$B_2$	0.20082128177	-0.21069981058	3.06745682700	3.46617053125

**Table 13:** Model parameters for the linear ARX model obtained from experiment CL 8

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-0.22720255465	-0.03132446634	-0.24092659818	-1.05096906795
$A_2$	-0.27416350698	0.01616883815	-0.21451716194	0.38970194695
B				
$B_0$	0	0	0	0
$B_1$	-0.03216084559	0.02783765963	-0.00710434710	-0.17452495416
$B_2$	0.18849169454	-0.13332033407	3.21192718092	2.68156100767

**Table 14:** Model parameters for the linear ARX model obtained from experiment CL 9

## 0.1.2 Model Parameters of Models Approximating System B

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.00779060540	-0.01982430460	-0.00669698192	-1.00577974178
$A_2$	-0.03090753047	0.06964146528	-0.01732037318	-0.07741226132
$A_3$	0.00687481794	0.01024726841	0.09060220336	-0.02142178838
$A_4$	0.20817842329	0.14650916294	-0.17720295660	-0.10861437316
$A_5$	-0.11325642850	-0.22954059695	0.09991475086	0.23126386876
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.23308196048	0.18380485365	-0.32987917406	0.30951867644
$B_2$	0.01385168928	-0.01249929151	0.00393552599	-0.00691405350
$B_3$	-0.00534224498	0.01425939680	0.04115511761	-0.03965053817
$B_4$	-0.01698373939	0.01906607760	0.03282468741	-0.03196380393
$B_5$	-0.11071224602	0.10006083631	0.10451415651	-0.10020629644

**Table 15:** Model parameters for the linear ARX model obtained from experiment NOL 1

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.09205646210	-0.18009788354	0.08264130209	-0.84547063939
$A_2$	0.03032499066	0.31154799908	-0.10702718914	-0.33144788177
$A_3$	0.17929310379	-0.06191085872	-0.06687894759	0.06088284265
$A_4$	-0.30945294275	-0.48675354903	0.21572881023	0.34260777524
$A_5$	0.22038633001	0.39963504877	-0.12635301022	-0.20360813067
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.24083758187	0.19315807102	-0.32655045591	0.31429987833
$B_2$	0.08567978640	-0.07659926150	-0.06751431906	0.06100119373
$B_3$	-0.02650209212	0.02525239705	0.07364486578	-0.06685751335
$B_4$	-0.03639510878	0.04927427012	0.06369340042	-0.06666177072
$B_5$	0.18159646002	-0.17460032386	-0.09450130419	0.09277011940

**Table 16:** Model parameters for the linear ARX model obtained from experiment NOL 2

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.85847488142	0.02398926872	0.05064682937	-1.86104337547
$A_2$	0.76071913241	-0.07165965222	-0.04903257334	0.87693294007
$A_3$	0.14164279285	0.01657898854	-0.00073789704	-0.01444070950
$A_4$	0.02833518620	0.03841570957	0.0346071982	0.06928001689
$A_5$	-0.06755011097	-0.00894925099	-0.02990706294	-0.06777619681
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.25270285779	0.18362466469	-0.279860093881	0.25469002880
$B_2$	0.22379585464	-0.16068563397	0.22837499210	-0.21106921228
$B_3$	0.03248578061	-0.01796706829	-0.00061501183	-0.00008163213
$B_4$	0.00048611405	-0.01301990321	0.00177894993	-0.00113481136
$B_5$	-0.02142288127	0.01663316895	-0.02498038644	0.02395966480

**Table 17:** Model parameters for the linear ARX model obtained from experiment NOL 3



Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.92006860924	-0.04836966715	0.04797748177	-1.91329927264
$A_2$	0.93480053777	0.05329017815	-0.02077891324	0.99123552070
$A_3$	0.11200660762	-0.04271546579	-0.03229052836	-0.06736710805
$A_4$	-0.07506103206	0.08021146912	-0.00865060862	0.04167168465
$A_5$	-0.04143788657	-0.04464535638	0.01865384835	-0.04404738701
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.18991783638	0.17633543959	-0.25193472608	0.214726214771
$B_2$	0.20714354503	-0.18700305562	0.21397343843	-0.1841853698
$B_3$	-0.01792465783	0.01230407290	-0.01001059473	0.00883565498
$B_4$	0.00048611405	-0.01301990321	-0.00853642447	-0.00199924156
$B_5$	-0.02499396562	0.02485112960	-0.00229233417	0.00392408965

**Table 18:** Model parameters for the linear ARX model obtained from experiment NOL 4

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.53375927843	0.22658160946	0.18708355418	-1.26741655361
$A_2$	0.67269874579	-0.29813721338	-0.29072400940	0.20424038412
$A_3$	-0.13025058335	0.17703085018	0.13036884804	0.03994323238
$A_4$	0.05424920199	-0.17336974243	-0.03659238368	-0.00429562156
$A_5$	-0.02929166414	0.05835009926	0.00542674510	0.03843579365
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.22750814662	0.17481022400	-0.33066693627	0.31817344528
$B_2$	0.04903639448	-0.02321399278	0.04707786896	-0.05435029888
$B_3$	-0.00044057631	0.00052566465	0.05128284697	-0.04310349554
$B_4$	-0.03635823383	0.03821547699	0.00305825300	-0.00652497254
$B_5$	0.00504566617	-0.02146965031	0.01504309738	-0.01254326425

**Table 19:** Model parameters for the linear ARX model obtained from experiment NOL 5

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.02330230763	0.00827106824	-0.01596992339	-1.01084852107
$A_2$	0.08336739801	-0.05116322064	0.00580034430	-0.01284217518
$A_3$	0.03814134902	0.04860700089	0.00659677193	0.04681396839
$A_4$	-0.03759125290	-0.04913099710	-0.01846024838	-0.03709246571
$A_5$	-0.02919306781	0.03292734173	0.03016913505	0.04061838117
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.00613141996	-0.00613141996	-0.00088006321	-0.00088006321
$B_2$	-0.00613141996	-0.00613141996	-0.00088006321	-0.00088006321
$B_3$	-0.00613141996	-0.00613141996	-0.00088006321	-0.00088006321
$B_4$	-0.00613141996	-0.00613141996	-0.00088006321	-0.00088006321
$B_5$	-0.00613141996	-0.00613141996	-0.00088006321	-0.00088006321

**Table 20:** Model parameters for the linear ARX model obtained from experiment NOL 6

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.114002892253	-0.05338478793	0.02738858062	-1.11883741108
$A_2$	0.14242078005	-0.04119998167	-0.03775028957	0.15251875982
$A_3$	0.03737727205	0.13319563205	0.00819033672	0.02630111623
$A_4$	-0.03250354385	-0.09500906209	-0.05345777889	-0.08732148267
$A_5$	-0.01505587345	0.05547319421	0.05742538562	0.04765961770
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.25006848782	0.2032518720	-0.32637138472	0.34474505317
$B_2$	0.04701722955	-0.02984412197	-0.00144704355	-0.03923475136
$B_3$	0.00543629234	-0.03035793950	0.00594319006	-0.00738877413
$B_4$	-0.03784746424	0.03286285141	-0.01025684615	0.01077415319
$B_5$	0.01566220987	-0.00568094039	0.03599468129	-0.02187573308

**Table 21:** Model parameters for the linear ARX model obtained from experiment NCL 1

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.11301160385	-0.0269242806	0.02420332459	-1.13461008448
$A_2$	0.11082500672	-0.08829302484	-0.03149642513	0.17811888597
$A_3$	0.08700195529	0.15154080440	0.00707647950	0.01438629105
$A_4$	-0.04232323370	-0.10931823652	-0.02979242783	-0.08513532261
$A_5$	-0.02360280313	0.07017770224	0.03067990719	0.04792701672
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.24749965791	0.19856873862	-0.31721937074	0.34699736010
$B_2$	0.02593127353	-0.01859365879	-0.00156039279	-0.04961429516
$B_3$	0.02890661862	-0.03919153271	0.01542599627	-0.00353180637
$B_4$	-0.02796951034	0.03516337797	-0.00720827905	0.00544434531
$B_5$	0.00553670580	-0.01369541195	0.02797600272	-0.02124670983

**Table 22:** Model parameters for the linear ARX model obtained from experiment NCL 2

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.11048787557	-0.04910182179	0.02820812890	-1.09180124782
$A_2$	0.13925235680	-0.03258808435	-0.05903603215	0.10254917922
$A_3$	0.05063460569	0.11010954468	0.04840348839	0.03295365450
$A_4$	-0.04622293483	-0.09391538879	-0.06231211329	-0.07321257208
$A_5$	-0.01195410298	0.06164038033	0.04545463819	0.04971441892
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.25711024863	0.20527831025	-0.31768826480	0.33323817006
$B_2$	0.04482470782	-0.02923171392	-0.00738136942	-0.03386423336
$B_3$	0.01281678569	-0.02531327670	0.02845830280	-0.01559315292
$B_4$	-0.03746834477	0.02819231404	-0.01167069670	0.00648723898
$B_5$	0.01180581676	-0.01152382941	0.03315737592	-0.02180329025

**Table 23:** Model parameters for the linear ARX model obtained from experiment NCL 3

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.01416966062	0.04509901196	-0.03866205513	-1.10186684370
$A_2$	0.01337859527	-0.06214108119	0.06066911029	0.03483680617
$A_3$	0.10197010802	0.04443914686	-0.04142016484	0.05334283952
$A_4$	-0.06380595939	-0.09660356136	0.02047993830	-0.07307137246
$A_5$	-0.01659875871	0.06640434037	0.00350599621	0.10353275520
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.23517021985	0.16350455419	-0.32994580983	0.32279683143
$B_2$	0.01637752456	0.00198399547	0.05216310095	-0.05002251207
$B_3$	0.01774128257	-0.02135827170	0.02579396474	-0.03651885061
$B_4$	-0.02387709330	0.02294364304	0.02815259858	-0.01768267312
$B_5$	0.02424959043	-0.01486247169	0.03137581454	-0.03520650800

**Table 24:** Model parameters for the linear ARX model obtained from experiment NCL 4

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.02931255332	0.00084461575	0.00110838085	-1.03692535303
$A_2$	0.06244715449	-0.03438255431	-0.01631473280	0.00763517615
$A_3$	0.05848848471	0.04886955197	0.03259090868	0.04317709933
$A_4$	-0.05028460864	-0.07105286076	-0.03976670585	-0.04193639550
$A_5$	-0.01707555813	0.05207151184	0.02356904503	0.04769740460
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.26075498721	0.20743209687	-0.31663609708	0.31827484135
$B_2$	0.01355561066	-0.00926026995	-0.00482322729	-0.02477900749
$B_3$	0.01365931909	-0.00905043179	0.04448628736	-0.01811339944
$B_4$	-0.04427381617	0.02496001105	-0.01551096542	-0.00035871237
$B_5$	0.01206321833	-0.01306626099	0.02081923837	-0.01176121848

**Table 25:** Model parameters for the linear ARX model obtained from experiment NCL 5

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.03552640782	-0.00113780594	0.00412227327	-1.02024268343
$A_2$	0.07161380813	-0.02454558154	-0.02346160964	-0.01180710915
$A_3$	0.05232078972	0.03695795056	0.03522385674	0.05893381383
$A_4$	-0.05212992860	-0.06740053155	-0.03550764402	-0.05100333392
$A_5$	-0.01219339149	0.05223406242	0.02106515806	0.04419856198
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.26116735104	0.20923804169	-0.31601390318	0.31618232917
$B_2$	0.01513231568	-0.01352949756	-0.00862673957	-0.01571908717
$B_3$	0.01019532289	-0.00394311546	0.04458602931	-0.02340267683
$B_4$	-0.04370543358	0.02316510909	-0.01618131762	0.00575329305
$B_5$	0.01762419333	-0.01763236910	0.01290994084	-0.00658906165

**Table 26:** Model parameters for the linear ARX model obtained from experiment NCL 6

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.11412930875	-0.14843607870	-0.05384951677	-1.31859151072
$A_2$	0.16325534664	0.42086398649	0.04881465447	0.3636052359
$A_3$	0.11066473944	-0.81490133460	-0.01757343457	0.12237954521
$A_4$	-0.09606272568	0.88265711502	-0.02261657167	-0.12226928979
$A_5$	-0.04120095383	-0.33666986541	0.04210523402	-0.03294412830
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.32176538676	0.25317419031	-0.32963506273	0.39207125237
$B_2$	0.06555836406	-0.13220927012	0.043024394452	-0.11755562439
$B_3$	0.05328119194	0.21914980801	0.00564490995	-0.041583073015
$B_4$	-0.06678759180	0.00360410188	0.00360410188	0.01967268392
$B_5$	-0.01027242782	0.10613904921	0.02652363194	0.00065973465

**Table 27:** Model parameters for the linear ARX model obtained from experiment NCL 7

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.09637569095	-0.03719963793	0.00360760749	-1.12512807010
$A_2$	0.07634517430	-0.04930291617	0.01176656140	0.14345780046
$A_3$	0.11066473944	0.11232067051	-0.01971221878	0.05376633125
$A_4$	-0.06180884789	-0.08047449626	-0.02826609492	-0.11343889001
$A_5$	-0.00630199195	0.05302841259	0.03356025367	0.06074848913
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.25153915975	0.20779334120	-0.32203352329	0.34323645660
$B_2$	0.02492646361	-0.02319253574	0.001376166722	-0.04656522642
$B_3$	0.02657878330	-0.0335880554	0.01366988815	-0.007979365715
$B_4$	-0.04292529022	0.02960344702	-0.01069412114	0.01270466562
$B_5$	0.01800769921	-0.00620082379	0.03237426749	-0.02345541112

**Table 28:** Model parameters for the linear ARX model obtained from experiment NCL 8

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.12363912109	-0.02816070424	0.03309928905	-1.13283271525
$A_2$	0.14270896356	-0.07937491109	-0.04942400280	0.16402705546
$A_3$	0.05123692721	0.14775520446	0.032316084758	0.02802288937
$A_4$	-0.04554734244	-0.10400686663	-0.05558731353	-0.08983342837
$A_5$	-0.00649570282	0.06193937781	0.04050178388	0.05094823329
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.252985851103	0.19880252416	-0.31693311316	0.34786286978
$B_2$	0.04048649763	-0.02071829655	-0.009784038312	-0.04637454715
$B_3$	0.01419194622	-0.03468224577	0.02116314560	-0.00833607974
$B_4$	-0.03927986459	0.03452383848	-0.01432664047	0.01076940004
$B_5$	0.01766723148	-0.00936094837	0.03134706616	-0.02193866773

**Table 29:** Model parameters for the linear ARX model obtained from experiment NCL 9

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.11411510047	-0.05657354173	0.00518687502	-1.11754722212
$A_2$	0.11340740639	-0.04953561887	-0.02223744167	0.16049782513
$A_3$	0.06780488525	0.13887805862	0.015558234158	0.00740081567
$A_4$	-0.01961492456	-0.11583603673	-0.04546445817	-0.09499475662
$A_5$	-0.02921021765	0.07922007107	0.04848808338	0.06543981160
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.254097456773	0.19934151027	-0.32221743601	0.34543093461
$B_2$	0.05218691052	-0.02766784525	-0.005976138802	-0.04532532367
$B_3$	0.01693313559	-0.03973569230	0.00915254294	-0.00277966215
$B_4$	-0.02689078042	0.03080987844	0.00465904885	0.00809017966
$B_5$	0.01295809081	-0.01597382096	0.03306420379	-0.02969961766

**Table 30:** Model parameters for the linear ARX model obtained from experiment NCL 10

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.12735809499	-0.03239482610	0.01572290021	-1.10451721833
$A_2$	0.14644813331	-0.08091017494	-0.02939100554	0.13669108103
$A_3$	0.07226560457	0.15538950379	0.015003501318	0.02642546894
$A_4$	-0.05529500844	-0.10851902993	-0.03345714221	-0.07130878024
$A_5$	-0.01559493971	0.06318563190	0.03165161786	0.03390567802
$B$	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.266253745323	0.20047125032	-0.31780098694	0.34588274284
$B_2$	0.05645247703	-0.01788148886	-0.002121736172	-0.03908157110
$B_3$	0.00982864098	-0.03981194765	0.00751772314	-0.01073813721
$B_4$	-0.03762579719	0.04047255858	-0.00602885133	0.00721699005
$B_5$	0.00676751332	-0.00978865712	0.02629735059	-0.01518604603

**Table 31:** Model parameters for the linear ARX model obtained from experiment NCL 11



Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.10720072914	-0.05673161879	0.02492721261	-1.08495455404
$A_2$	0.13213526240	-0.00625994581	-0.05887883272	0.07049251323
$A_3$	0.05515001871	0.08857139227	0.052330369968	0.03806720625
$A_4$	-0.04408303037	-0.08570606040	-0.06631912262	-0.06514521887
$A_5$	-0.01417025601	0.05612835291	0.04822927681	0.06099235942
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.260523887003	0.20887047973	-0.31861275899	0.32489651486
$B_2$	0.04680612546	-0.03337486351	-0.000462660792	-0.031924726559
$B_3$	0.01350282526	-0.02085232344	0.03614610764	-0.02294534346
$B_4$	-0.03460215898	0.02455817550	-0.00643749536	0.00084837681
$B_5$	0.00915946870	-0.01132288716	0.03705053704	-0.02577863379

**Table 32:** Model parameters for the linear ARX model obtained from experiment NCL 12

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.04871126093	0.03795250741	-0.03530447684	-1.12107314963
$A_2$	0.02122868488	-0.03756415066	0.06440042499	0.01052885887
$A_3$	0.10589212362	0.02849460049	-0.046435271458	0.06876296267
$A_4$	-0.06836981432	-0.08628458431	0.02132579066	-0.06547575776
$A_5$	0.00893484647	0.05570728309	0.00002790269	0.12105556536
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.237227059243	0.17050977233	-0.33101405789	0.31442497739
$B_2$	0.02030753339	-0.00754208838	0.065664975092	-0.05407509470
$B_3$	0.02212758844	-0.01738680776	0.03456920387	-0.04743135366
$B_4$	-0.02388545461	0.01997765520	0.03540012251	-0.02451168309
$B_5$	0.02467941722	-0.01605595050	0.03624111265	-0.03896281875

**Table 33:** Model parameters for the linear ARX model obtained from experiment NCL 13

Coefficient	Parameter Values $\times 10^4$			
	A	$a_{11}$	$a_{12}$	$a_{21}$
$A_0$	1	0	0	1
$A_1$	-1.05150503819	0.00275228775	0.00100936625	-1.05521730333
$A_2$	0.06910123122	-0.02526841537	0.05757548532	0.04430822733
$A_3$	0.05757548532	0.04675334297	0.03197556655	0.06876296267
$A_4$	-0.04698709556	-0.07031525249	-0.04082889916	-0.03785429897
$A_5$	-0.00515556068	0.04294618057	0.02499598787	0.06587403651
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.265267574673	0.21168008449	-0.32009547396	0.31147068462
$B_2$	0.01859912284	-0.01543428954	0.008243031952	-0.02752213870
$B_3$	0.01844277308	-0.00905364672	0.05151053402	-0.02560675990
$B_4$	-0.03961871492	0.02172078896	-0.00659727021	-0.00759606455
$B_5$	0.01358231687	-0.01500906007	0.02612260725	-0.01812213031

**Table 34:** Model parameters for the linear ARX model obtained from experiment NCL 14

Coefficient	Parameter Values $\times 10^4$			
	A	$a_{11}$	$a_{12}$	$a_{21}$
$A_0$	1	0	0	1
$A_1$	-1.05385637088	0.00605945815	-0.00214685229	-1.03337385640
$A_2$	0.07745154073	-0.03270220848	-0.02346946846	-0.00633580150
$A_3$	0.05151141681	0.04055084910	0.03358495922	0.06050956842
$A_4$	-0.04492298298	-0.06293607016	-0.03564005419	-0.04290434077
$A_5$	-0.00721629029	0.04539525057	0.02753412840	0.04198206075
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.26751812283	0.20869874886	-0.31792275377	0.31611660340
$B_2$	0.02306029153	-0.01445152723	-0.00059347846	-0.01952386269
$B_3$	0.01698424453	-0.00674943044	0.04631495022	-0.02859207779
$B_4$	-0.03762647497	0.01793306890	-0.01030024883	0.00035806418
$B_5$	0.01608192473	-0.01791729845	0.01745773018	-0.0085982361

**Table 35:** Model parameters for the linear ARX model obtained from experiment NCL 15

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.07653936026	-0.08577367408	-0.05274428659	-1.21382717130
$A_2$	0.11568317366	0.24128866916	0.037884040263	0.23189535666
$A_3$	0.09290207093	-0.49710279904	-0.01274444526	0.08819374944
$A_4$	-0.06203556356	0.54011557574	-0.02081904203	-0.09068725626
$A_5$	-0.04676733328	-0.19673110252	0.04475660718	0.00055511083
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.30409179640	0.23716901217	-0.326258476817	0.36098213137
$B_2$	0.04164287888	-0.08374360998	0.04008309321	-0.08440790850
$B_3$	0.04084527622	0.13337716124	0.01138576608	-0.03587818898
$B_4$	-0.04515588081	-0.14798349498	0.00907493622	0.00840545243
$B_5$	-0.01108775242	0.06757701895	0.02760952111	-0.00946298157

**Table 36:** Model parameters for the linear ARX model obtained from experiment NCL 16

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.11373017990	-0.05737590102	0.05319841125	-1.16373553639
$A_2$	0.12518172393	-0.04125307507	-0.05858720138	0.19656205438
$A_3$	0.06948540813	0.12258736324	0.00961452786	0.01044793555
$A_4$	-0.05673127121	-0.07831754025	-0.05515629765	-0.10335960379
$A_5$	-0.00706097638	0.05123262260	0.05271534205	0.07866783558
$B$	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.24019694380	0.19939997825	-0.32056446491	0.35239971161
$B_2$	0.03547295451	-0.03380831234	-0.01074747620	-0.05181964327
$B_3$	0.02568743102	-0.03120224851	0.01723257148	-0.00782832480
$B_4$	-0.03908499040	0.02826817735	-0.00415623646	0.00505771832
$B_5$	0.013483716492	-0.00716646356	0.04445815366	-0.03321700533

**Table 37:** Model parameters for the linear ARX model obtained from experiment NCL 17

## 0.2 Models Identified to Approximate the Pilot Scale Distillation Column

It is important to note that the discretisation step size of these models is 10 seconds.

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.64226253762	0.04386878063	0.14191751213	-0.91590198231
$A_2$	0.79110206508	-0.12145038113	-0.03986093134	0.04786096310
$A_3$	-0.14202958224	0.02046402331	0.04212848184	-0.09333211826
$A_4$	0.02756155956	0.11146970816	-0.22952954342	-0.09023278471
$A_5$	-0.10501517278	-0.12843701332	0.12576498416	0.02059519201
$A_6$	0.09794104179	0.12414002523	-0.09254680973	0.08119184072
$A_7$	0.00365694080	-0.10241297107	0.10374837974	0.02107932502
$A_8$	-0.02009837627	0.04275679039	-0.02720402710	-0.01869916421
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.04004651467	0	-0.00121942216	0.00433566399
$B_2$	0.00660432404	0	-0.01182523719	0.02492642536
$B_3$	0.02908581241	0.00045717707	-0.01298954445	0.00536921903
$B_4$	-0.00773245465	0.00306474281	-0.01097624598	0.00318133343
$B_5$	0.00240040914	-0.00532951121	-0.00049305569	-0.00597835830
$B_6$	0.002971553312	-0.00139781606	-0.00772280631	-0.00683025422
$B_7$	0.00110354397	-0.00139913805	0.00847554225	-0.00523924563
$B_8$	0.00036153449	0.00131508928	0.01372125291	-0.00202618118
$B_9$	0	0.00193401670	0	0
$B_{10}$	0	-0.00120400267	0	0

**Table 38:** Model parameters for the linear ARX model obtained from experiment DOL 1

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-1.32739822224	0.14864943311	0.04692083970	-0.68387567791
$A_2$	0.67598917475	-0.03283379840	-0.10716446036	-0.14122396444
$A_3$	-0.2547372076	-0.06189077444	0.02800139637	-0.21659117290
$A_4$	0.05481041256	0.02257495630	0.07513827964	0.10258369581
$A_5$	-0.10427751513	-0.07301546741	-0.11611063475	-0.08691222848
$A_6$	-0.07750742015	-0.02050423096	0.04351194751	-0.01550065805
$A_7$	-0.02190625396	-0.01819378944	-0.01698983443	0.06617591185
$A_8$	0.08072738619	0.01110396287	0.04241541419	0.014883204474
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.0567833756	0	-0.01134708982	0.00247048766
$B_2$	-0.00771854441	0	0.01494759336	0.02084047380
$B_3$	0.01537373656	-0.00077893790	0.01144510508	0.00341830618
$B_4$	-0.02204413225	0.00413891291	-0.02505321861	-0.00108043383
$B_5$	0.01564529096	0.00552055302	0.00693788846	-0.00434503956
$B_6$	0.02094011488	0.00135685050	-0.01031289677	-0.00851896190
$B_7$	0.00017735557	0.00377741850	0.03105878373	-0.00775707277
$B_8$	0.02593325391	-0.00121619018	-0.01333672847	-0.00250144808
$B_9$	0	-0.00674814722	0	0
$B_{10}$	0	-0.00510315207	0	0

**Table 39:** Model parameters for the linear ARX model obtained from experiment DCL 1

Coefficient	Parameter Values $\times 10^4$			
A	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
$A_0$	1	0	0	1
$A_1$	-1.03509467472	-0.02038863879	0.13967008092	-0.72809863803
$A_2$	0.30722473049	0.03510090506	-0.2757522994	0.07944438510
$A_3$	-0.14180755160	-0.06642868548	0.21022381736	-0.32235583778
$A_4$	-0.11476570779	-0.00480259269	-0.13764522287	0.11392406161
$A_5$	0.08619376088	0.04274411055	0.07015117041	-0.07337318275
$A_6$	-0.06414386327	-0.01669625230	0.00490367732	0.01290153671
$A_7$	0.02531270102	-0.00297931647	-0.01698983443	0.06617591185
$A_8$	-0.04300507468	0.02487854825	0.08813789358	-0.02674937310
B	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.08703476242	0	-0.02111664438	0.00618452960
$B_2$	-0.01807136818	0	0.03288578973	0.01376425899
$B_3$	0.04077365902	-0.00519381920	-0.02647845080	-0.00210561914
$B_4$	-0.01556834220	0.00880381991	0.00611460398	0.00275146928
$B_5$	0.01921162480	0.00627827603	0.00898031289	-0.00244696755
$B_6$	0.02361350641	0.00423420216	-0.02040432214	-0.00358004095
$B_7$	-0.02726660783	0.00038021325	-0.02977485254	-0.00353951398
$B_8$	0.05488545845	-0.00380990356	0.04043511672	-0.00335217107
$B_9$	0	-0.00363316179	0	0
$B_{10}$	0	-0.00413281802	0	0

**Table 40:** Model parameters for the linear ARX model obtained from experiment DCL 2

Coefficient	Parameter Values $\times 10^4$			
	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$
A				
$A_0$	1	0	0	1
$A_1$	-0.45884675950	-0.06320329927	0.46479163808	-0.75177031383
$A_2$	-0.18404270255	0.16330901072	-0.44320168347	-0.01900154285
$A_3$	0.24665581214	-0.10143586768	0.10393677207	-0.16468915843
$A_4$	-0.02333115412	-0.10777608572	-0.10322483613	0.03601071966
$A_5$	-0.20023817026	0.16954240234	0.07950244572	-0.08279080657
$A_6$	0.01204728160	-0.04482029811	-0.04498715983	-0.02933835196
$A_7$	0.08318314049	-0.07271697329	-0.05709992482	0.12459628636
$A_8$	-0.11903945519	0.03523598038	0.01489475627	-0.02788312122
B				
	$b_{11}$	$b_{12}$	$b_{21}$	$b_{22}$
$B_0$	0	0	0	0
$B_1$	-0.12352688561	0	-0.09101296532	-0.00553615279
$B_2$	-0.05037248407	0	0.02257359158	0.02387416365
$B_3$	0.02339795732	0.00215803760	-0.05844375438	0.00488654781
$B_4$	0.10344138459	0.00460681511	0.15045443536	0.00962286357
$B_5$	-0.09254994127	0.01283884431	-0.07280729473	-0.00003420248
$B_6$	0.09414164413	0.00016623467	-0.03504722112	-0.00615814174
$B_7$	-0.11305132830	0.00168267534	0.00043619575	-0.00582530786
$B_8$	0.12357695305	-0.00708186350	0.04354877817	-0.00680767009
$B_9$	0	-0.00584745615	0	0
$B_{10}$	0	-0.00167879767	0	0

**Table 41:** Model parameters for the linear ARX model obtained from experiment DCL 3