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ALL CALCULATED VALUES ARE STEADY STATE VALUES.

RED COLOR INDICATES WHERE VALUES ARE RETRIEVED FROM

Script contains 25 sections, each containing one run. A run is just a continuous test. To save time during testing, some runs contain several tests, e.g RUN005 port thruster angle=0,30,60,90° and calculates 4 values for mean, variance, min and max.

main.m depends on two quite similar functions. filter_data() returns values from runs that contain only one test. filter_data_joined() returns values from runs that contain several tests. Sample frequency used is 200Hz.

Use "Run Section" for each section. Mean, variance, min and max values are displayed in the console. For runs with only one test(e.g port thruster=25%) there will be only one mean value. For runs containing several tests there will be several means etc.

You can add and remove data from plots by adding/removing e.g 'sideforce_ap' to the display_data cell array

Note: Force Total = (Force Aft - Force Bow)

```
clear all;close all;
```

Run 001 - Port Thruster 25% effort

```
clc
title = 'Run 001 - Port Thruster 25% effort';
disp(title)
disp(' ')
load('num25-run001-PT.mat')
display_data = {'time', 'force_bow', 'force_aft', 'rps_port', ...
    'sideforce_ap', 'sideforce_fp'};
%boundaries are lower and upper sample number for a steady-state period
fs=200; % Hz
boundaries =[40 105]*fs; %[t1 t2]*fs
% returns the mean, variance, max and min values of the selected data in
% num25 specified by the active set and boundaries.
filter_data(num25, display_data, title, boundaries);
```

Run 001 - Port Thruster 25% effort

'F_{sideFP}[N]'

Mean value: -0.179625

Variance: 0.007032

Max: 0.714222

Min: -1.161919

'F_{sideAP}[N]'

Mean value: -0.025240

Variance: 0.011541

Max: 1.787384

Min: -1.677095

'RPS_{port}'

Mean value: 3.770719

Variance: 0.004994

Max: 4.006588

Min: 3.536623

'F_{Bow}[N]'

Mean value: -1.031830

Variance: 0.001567

Max: -0.919750

Min: -1.149750

'F_{Aft}[N]'

Mean value: 1.063429

Variance: 0.002354

Max: 1.218965

Min: 0.922804

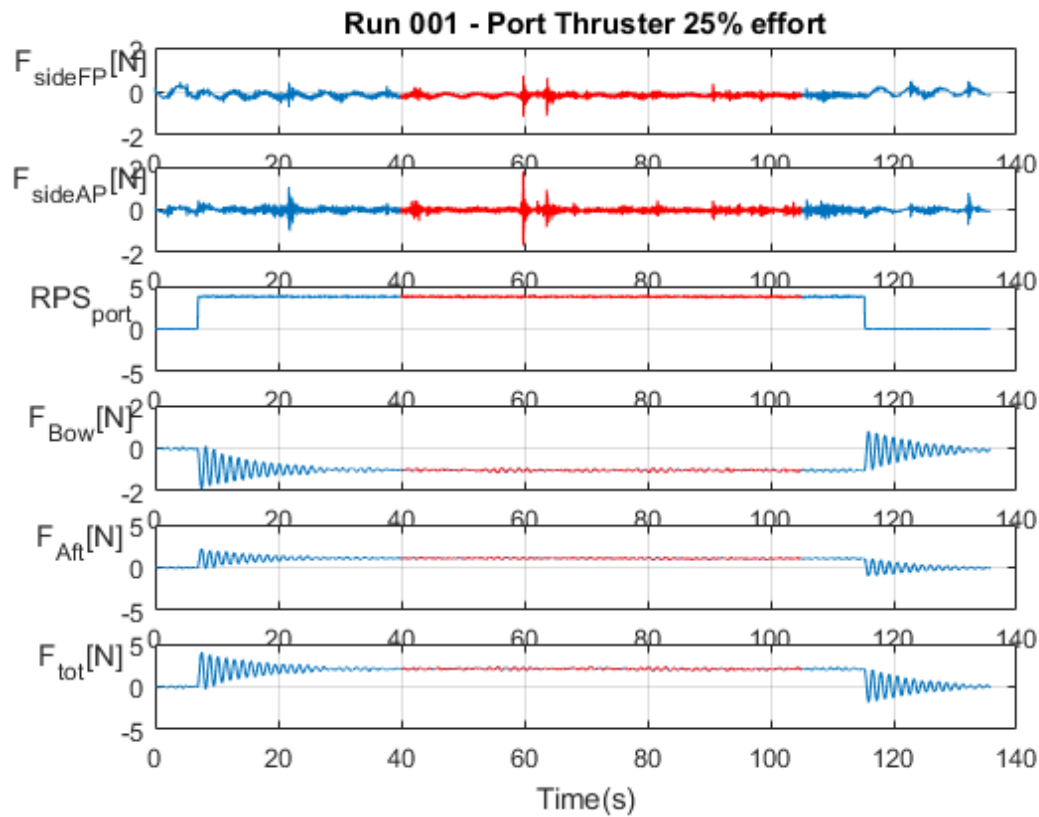
'F_tot [N] (F_aft-F_bow)'

Mean value: 2.095259

Variance: 0.007372

Max: 2.368416

Min: 1.842827



Run 002 - Port Thruster 50% effort

```
clc
title = 'Run 002 - Port Thruster 50% effort';
disp(title)
disp(' ')
load('num50-run002-PT.mat')
display_data = {'time', 'force_bow', 'force_aft', 'rps_port' , ...
    'sideforce_ap', 'sideforce_fp'};
boundaries = [8000 21000];
filter_data(num50, display_data, title, boundaries);
```

Run 002 - Port Thruster 50% effort

'F_{sideFP} [N]'

Mean value: -0.549732

Variance: 0.025343

Max: -0.093181

Min: -1.053398

'F_{sideAP} [N]'

Mean value: -0.072300

Variance: 0.014202

Max: 0.777895

Min: -1.046432

'RPS_{port}'

Mean value: 6.926967

Variance: 0.006869

Max: 7.238001

Min: 6.613867

'F_{Bow}[N]'

Mean value: -3.305037

Variance: 0.003438

Max: -3.105948

Min: -3.482394

'F_{Aft}[N]'

Mean value: 3.686637

Variance: 0.004694

Max: 3.907324

Min: 3.461991

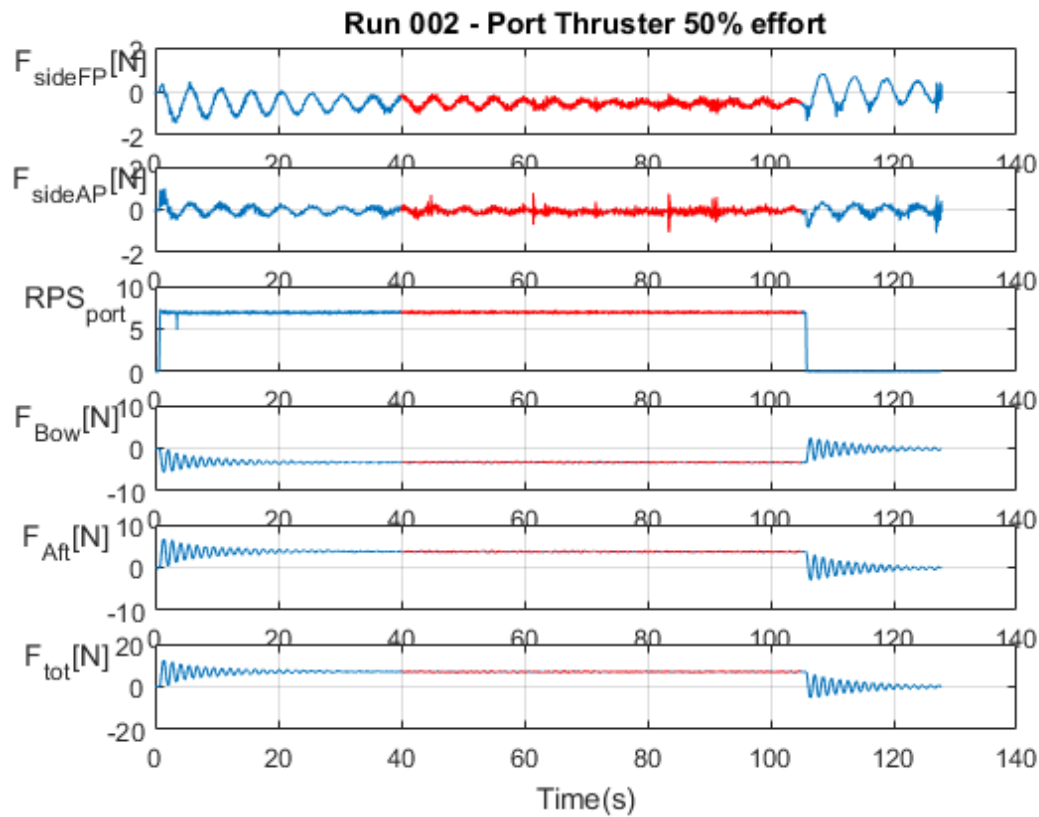
'F_tot [N] (F_aft-F_bow)'

Mean value: 6.991675

Variance: 0.015891

Max: 7.384536

Min: 6.570036



Run 003 - Port Thruster 75% effort

```
clc
title = 'Run 003 - Port Thruster 75% effort';
disp(title)
disp(' ')
load('num75-run003-PT.mat')
display_data = {'time', 'force_bow', 'force_aft', 'rps_port', ...
    'sideforce_ap', 'sideforce_fp'};
boundaries = [8000 21000];
filter_data(num75, display_data, title, boundaries);
```

Run 003 - Port Thruster 75% effort

'F_{sideFP} [N]'

Mean value: -1.027997

Variance: 0.067493

Max: -0.260834

Min: -1.795069

'F_{sideAP} [N]'

Mean value: -0.090793

Variance: 0.035095

Max: 0.506626

Min: -0.945053

'RPS_{port}'

Mean value: 9.602590

Variance: 0.010844

Max: 9.981113

Min: 9.284322

'F_{Bow}[N]'

Mean value: -6.242944

Variance: 0.013989

Max: -5.883318

Min: -6.609256

'F_{Aft}[N]'

Mean value: 7.329696

Variance: 0.024166

Max: 7.791782

Min: 6.884754

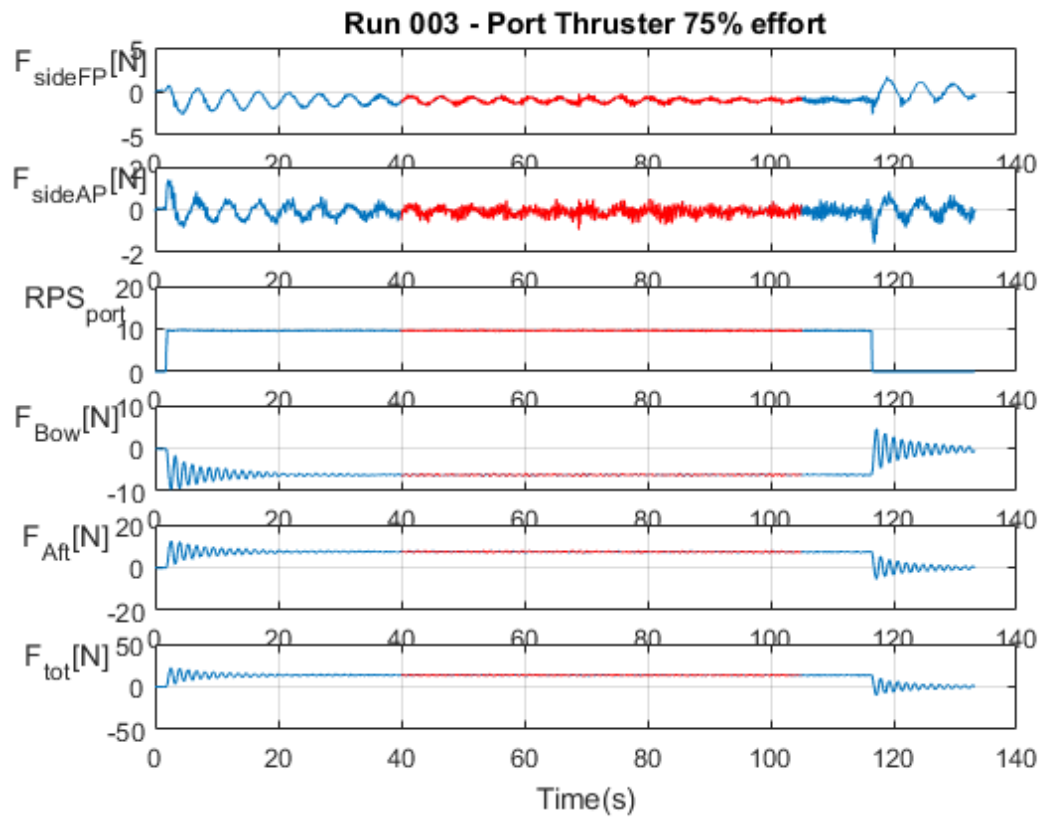
'F_tot [N] (F_aft-F_bow)'

Mean value: 13.572640

Variance: 0.074295

Max: 14.400438

Min: 12.778254



Run 004 - Port Thruster 100% effort

```
clc
title = 'Run 004 - Port Thruster 100% effort';
disp(title)
disp(' ')
load('num100-run004-PT.mat')
display_data = {'time', 'force_bow', 'force_aft', 'rps_port', ...
    'sideforce_ap', 'sideforce_fp'};
boundaries = [8000 21000];
filter_data(num100, display_data, title, boundaries);
```

Run 004 - Port Thruster 100% effort

'F_{sideFP} [N]'

Mean value: -1.360171

Variance: 0.080818

Max: -0.497088

Min: -2.162194

'F_{sideAP} [N]'

Mean value: -0.076435

Variance: 0.059194

Max: 0.814121

Min: -0.667784

'RPS_{port}'

Mean value: 11.044530

Variance: 0.014274

Max: 11.500520

Min: 10.705328

'F_{Bow}[N]'

Mean value: -8.332575

Variance: 0.014540

Max: -7.913787

Min: -8.749034

'F_{Aft}[N]'

Mean value: 9.752919

Variance: 0.028349

Max: 10.316788

Min: 9.217773

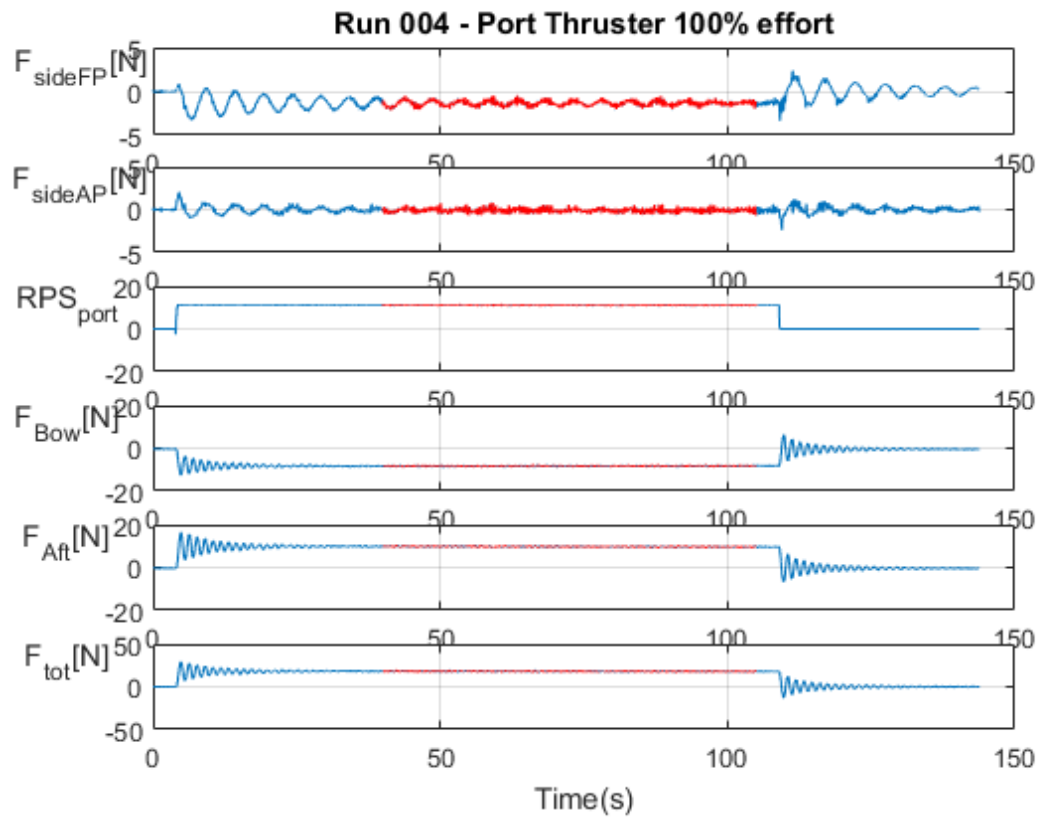
'F_tot [N] (F_aft-F_bow)'

Mean value: 18.085494

Variance: 0.082702

Max: 19.065223

Min: 17.132159



Run 005 - Port Thruster effort=100% angle=0,30,60,90°

```
title = 'Run 005 - Port Thruster 100% effort at 0,30,60,90°';
disp(title)
disp(' ')
load 'num-run005-0-30-60-90-deg.mat';
display_data = {'time', 'force_bow', 'force_aft', 'sideforce_ap', ...
    'sideforce_fp', 'rps_port'};
fs=200;
% starting points and stop points for multiple steady states
boundaries = {[12 48]*fs,[76 113]*fs,[136 176]*fs,[203 240]*fs};
filter_data_joined(num,display_data, title, boundaries);
```

Run 005 - Port Thruster 100% effort at 0,30,60,90°

```
F_{sideFP}[N]
Mean:      -1.338934  -2.303268  -2.779349  -2.719018
Variance:  0.320877  2.235070  2.482270  0.153812
Max:       -0.000592  1.871771  0.942873  -1.725331
Min:       -2.554857  -5.779917  -7.222108  -3.836359
```

```
F_{sideAP}[N]
Mean:       -0.084996  -7.164886  -12.988836  -15.625651
Variance:   0.086452  0.435895  0.493320  0.045954
Max:        0.749326  -5.295836  -11.356043  -14.748832
Min:       -0.804672  -8.867694  -16.389476  -16.350967
```

RPS_{port}

Mean:	11.046712	11.289256	10.980959	10.762547
Variance:	0.015560	0.015449	0.028507	0.014778
Max:	11.462405	11.774498	11.611398	11.210230
Min:	10.734249	10.946313	10.601516	10.421080

F_{Bow} [N]

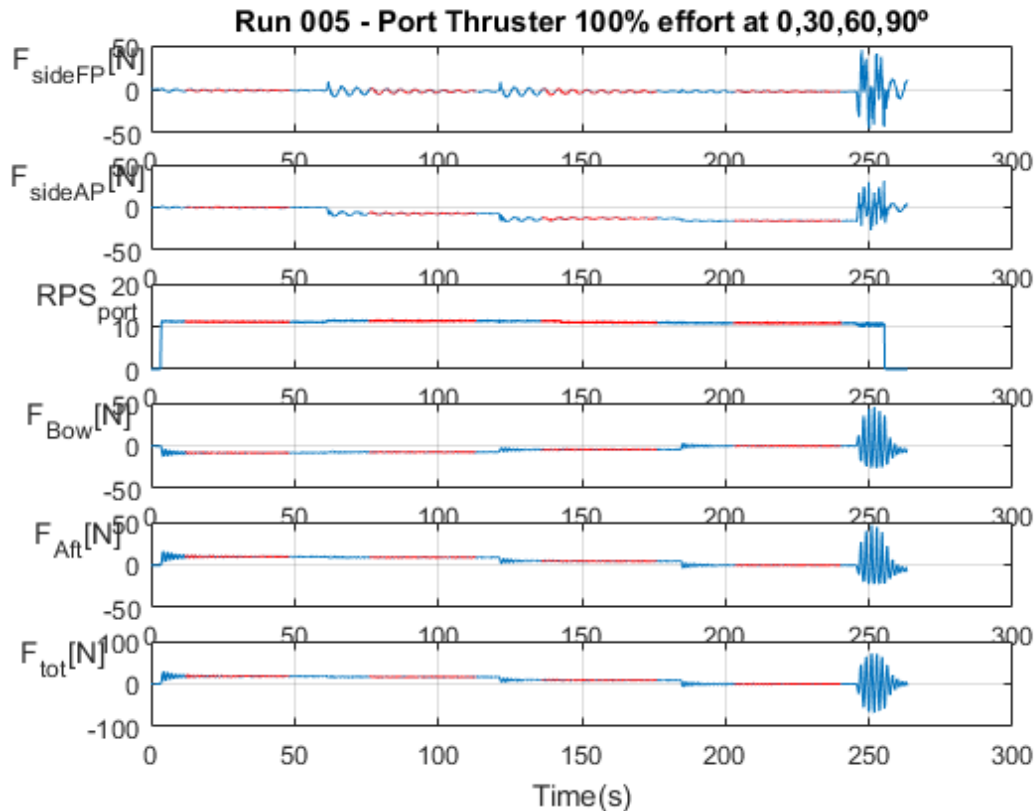
Mean:	-8.414880	-7.637176	-4.508101	-0.455068
Variance:	0.142400	0.016222	0.038525	0.010155
Max:	-7.246547	-7.314529	-4.010076	-0.152185
Min:	-9.704373	-7.982667	-5.267289	-0.780493

F_{Aft} [N]

Mean:	9.508528	8.689563	4.245307	-0.542055
Variance:	0.261706	0.026421	0.060911	0.012684
Max:	11.302083	9.069693	5.143784	-0.168575
Min:	7.927590	8.247477	3.656705	-0.879525

F_{tot} [N] F_{aft}-F_{bow}

Means:	17.923407	16.326739	8.753409	-0.086987
Variances:	0.790011	0.082396	0.192225	0.045160
Maxes:	21.004659	17.050451	10.410175	0.611372
Minima:	15.174138	15.562279	7.745736	-0.725704



RUN 006 - Starboard Thruster effort=100%

angle = 0,30,60,90,120,150,180,210,240°

```
clc
title= 'Run 006 - Starboard Thruster 100% effort at 0-240° inc=30°';
disp(title)
disp('Order: 0, 30, 60, 90, 120, 150, 180, 210, 240°')
disp(' ')
load 'num-run-006-0-240-deg.mat'
display_data = {'time', 'force_bow', 'force_aft', 'sideforce_ap', ...
    'sideforce_fp', 'rps_star'};
fs=200;
% Boundaries are in 'sample number'
% sample number = seconds * sample frequency
boundaries = {[16 59]*fs, [91 137]*fs, [157 185]*fs, [207 232]*fs, ...
    [260 289]*fs, [314 352]*fs, [368 394]*fs, [407 436]*fs, [489 569]*fs};
filter_data_joined(num0_240, display_data, title, boundaries);
```

Run 006 - Starboard Thruster 100% effort at 0-240° inc=30°

Order: 0, 30, 60, 90, 120, 150, 180, 210, 240°

F_{sideFP}[N]

```
Mean:      1.337343  -0.384025  -1.717088  -2.232670  -2.836831  -2.112332  -1.953482  -
0.793652  1.429348
Variance:  0.140665  2.027450  3.838882  1.249442  3.630016  0.625777  7.744311  26.3502
56  0.423611
Max:       2.584172  3.505059  2.828346  0.075701  0.444238  -0.397716  3.702437  9.8399
20  3.767577
Min:       0.399400  -4.635842  -5.805727  -5.549400  -6.324756  -4.058638  -8.608764  -
10.859860  -0.323243
```

F_{sideAP}[N]

```
Mean:      -1.285261  -10.325054  -15.708439  -12.748332  -12.841609  -6.689006  0.17175
8  7.679885  14.179703
Variance:  0.103517  0.483272  0.984771  0.682822  0.967887  0.217292  1.426406  4.78021
8  0.117518
Max:       -0.363110  -8.032796  -12.319590  -10.700484  -10.130497  -5.547447  3.397759
13.519344  15.599223
Min:       -2.327146  -12.408924  -18.344960  -15.180587  -15.424989  -8.339619  -2.4328
24  3.010379  13.082036
```

RPS_{star}[RPS]

```
Mean:      11.562668  11.378608  11.306171  11.247205  11.173170  11.155962  11.127753
11.111954  10.960533
Variance:  0.008887  0.007669  0.008519  0.010832  0.007700  0.009999  0.009890  0.01211
4  0.008257
Max:      11.873567  11.617209  11.533893  11.509664  11.379267  11.396682  11.375914
11.387705  11.158957
Min:      11.256876  11.104792  11.097680  10.980399  10.956900  10.884076  10.845108
10.799245  10.639833
```

F_{Bow} [N]

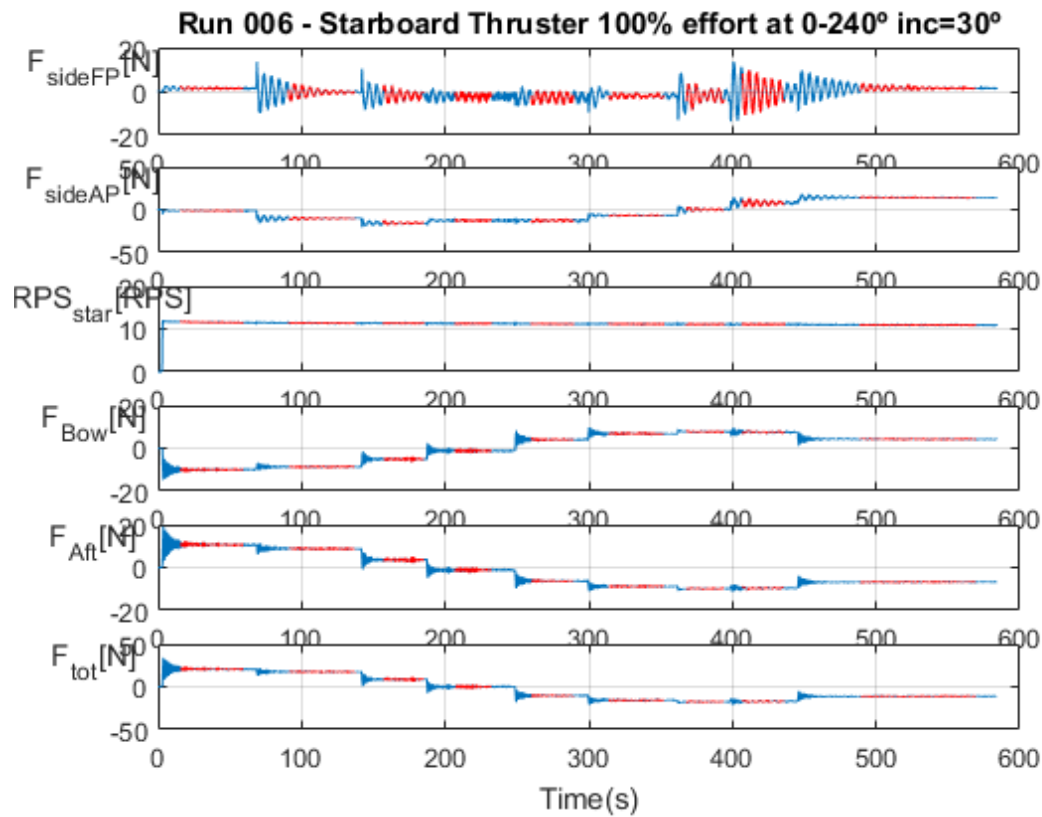
Mean: -10.042823 -8.719167 -5.094076 -1.219793 4.064620 6.841420 7.713469 7.513831 4.246905
Variance: 0.115390 0.044863 0.164753 0.247058 0.065987 0.087574 0.036848 0.099618 0.010994
Max: -9.115297 -8.184217 -3.885792 -0.106964 4.912307 7.554312 8.055640 8.323075 4.546044
Min: -11.181404 -9.297081 -6.260961 -2.318318 3.201682 6.088661 7.191643 6.808310 3.964755

F_{Aft} [N]

Mean: 10.698541 8.791022 3.534049 -1.226818 -6.268793 -8.842529 -9.852649 -9.680326 -6.811693
Variance: 0.232925 0.082900 0.254980 0.314985 0.063115 0.070797 0.028248 0.057700 0.009660
Max: 12.353647 9.584293 4.988613 0.064318 -5.484206 -8.100024 -9.398934 -9.107681 -6.543950
Min: 9.381398 8.046491 2.116448 -2.476505 -7.041370 -9.461657 -10.159790 -10.372502 -7.108729

F_{tot} [N] F_{aft}-F_{bow}

Means: 20.741363 17.510189 8.628126 -0.007024 -10.333412 -15.683950 -17.566119 -17.194157 -11.058598
Variances: 0.676030 0.248726 0.822806 1.118840 0.251427 0.314751 0.128415 0.299631 0.040679
Maxes: 23.534452 18.881375 11.248210 2.380727 -8.689128 -14.190594 -16.592074 -15.942989 -10.510202
Minima: 18.498792 16.232098 6.003658 -2.367087 -11.947763 -17.015070 -18.210249 -18.685488 -11.637484



RUN 007 Starboard Thruster effort=100% at angle=270°

```

clc
title= 'Run 007 - Starboard Thruster 100% effort at 270°';
disp(title)
disp(' ')
load 'num-run-007-270-deg.mat'
display_data = {'time', 'force_bow', 'force_aft', 'sideforce_ap', ...
    'sideforce_fp', 'rps_star'};
fs=200;
boundaries = [102*fs 170*fs];
filter_data(num270, display_data, title, boundaries);

```

Run 007 - Starboard Thruster 100% effort at 270°

'F_{sideFP} [N]'

Mean value: 2.714466

Variance: 0.930647

Max: 5.004788

Min: 0.362664

'F_{sideAP} [N]'

Mean value: 16.339723

Variance: 0.192587

Max: 17.719716

Min: 14.980292

'RPS_{star}'

Mean value: 10.820581

Variance: 0.010997

Max: 11.077588

Min: 10.454109

'F_{Bow}[N]'

Mean value: 0.291800

Variance: 0.016990

Max: 0.738466

Min: -0.080011

'F_{Aft}[N]'

Mean value: -0.156783

Variance: 0.019276

Max: 0.258759

Min: -0.602454

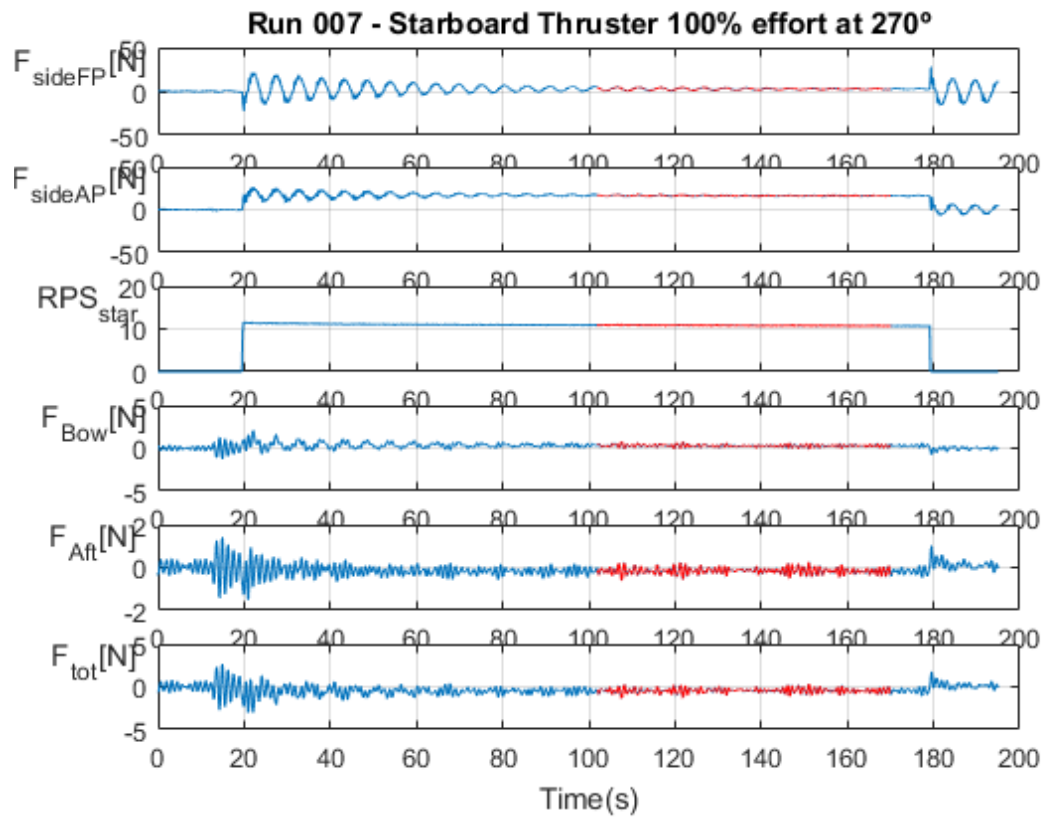
'F_tot [N] (F_aft-F_bow)'

Mean value: -0.448583

Variance: 0.070890

Max: 0.337000

Min: -1.339123



RUN 008 - Bow Thruster effort=25,50,75,100% angle=0°

```

clc
title = 'Run 008 - Bow Thruster at 25, 50, 75 and 100% effort';
disp(title)
disp('Order: 25%, 50%, 75% then 100% effort')
load 'num-run008-25-50-75-100-effort-0deg.mat'
display_data = {'time', 'force_bow', 'force_aft', 'rps_bow', ...
    'sideforce_ap', 'sideforce_fp'};
fs=200;
boundaries = {[40 75]*fs, [100 138]*fs, ...
    [165 213]*fs, [245 282]*fs};
filter_data_joined(num, display_data, title, boundaries);

```

Run 008 - Bow Thruster at 25, 50, 75 and 100% effort

Order: 25%, 50%, 75% then 100% effort

F_{sideFP} [N]

Mean: 0.024496 -0.093193 -0.482197 -0.921885

Variance: 0.022983 0.009501 0.032302 0.206473

Max: 0.433495 0.282866 0.684178 0.466224

Min: -0.386973 -0.438548 -1.399493 -1.869086

F_{sideAP} [N]

Mean: 0.016354 0.076782 0.223821 0.398142

Variance: 0.006320 0.003144 0.013568 0.071071

Max: 0.325586 0.387425 0.884020 1.182649

Min: -0.257432 -0.190488 -0.479042 -0.305972

RPS_{Bow}

Mean: 1.733985 10.921960 22.964829 33.346203

Variance: 0.035170 0.004420 0.054052 0.004234

Max: 2.142778 11.138883 23.418942 33.543159

Min: 1.230328 10.744573 22.441317 33.142675

F_{Bow} [N]

Mean: -0.372871 -0.795033 -2.297997 -4.343381

Variance: 0.001994 0.001257 0.008386 0.006880

Max: -0.230349 -0.661300 -2.050284 -4.119985

Min: -0.574151 -0.914659 -2.550714 -4.600349

F_{Aft} [N]

Mean: -0.297855 0.173884 2.003155 4.647431

Variance: 0.002538 0.001623 0.011386 0.011066

Max: -0.069854 0.306211 2.301072 4.975523

Min: -0.455464 0.022321 1.714204 4.357293

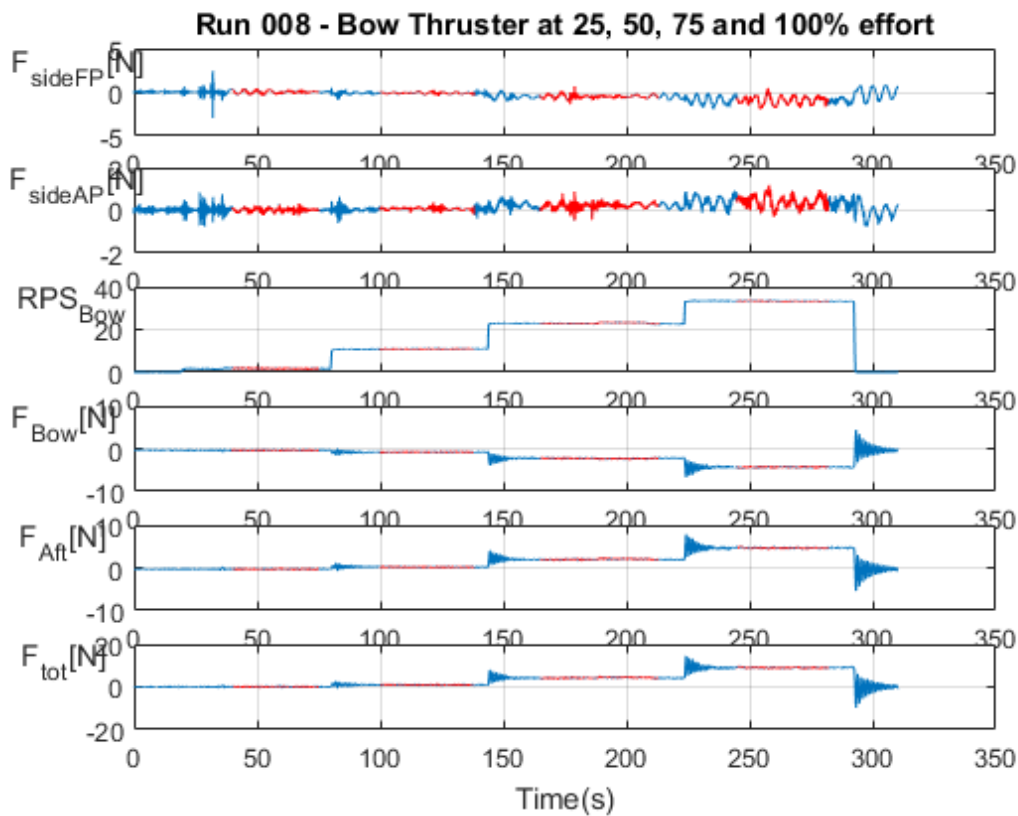
F_{tot} [N] F_{aft}-F_{bow}

Means: 0.075016 0.968917 4.301152 8.990812

Variances: 0.008995 0.005702 0.039256 0.035353

Maxes: 0.502527 1.219779 4.849390 9.570209

Minima: -0.223125 0.685530 3.765686 8.481171



RUN 009 - Bow Thruster effort=100% angle=0,30,60,90,120,150°

```
clc
title = 'Run 009 Bow Thruster at 100% at 0-150° inc=30°';
disp(title)
disp('Order: 0, 30, 60, 90, 120, 150°')
disp(' ')
load 'num-run009-100-effort-0-150deg.mat'
display_data = {'time', 'force_bow', 'force_aft', 'rps_bow', ...
    'sideforce_ap', 'sideforce_fp'};
fs=200;
boundaries = {[33 54]*fs, [82 105]*fs, [130 148]*fs, [177 198]*fs, ...
    [223 242]*fs, [266 288]*fs};
filter_data_joined(num, display_data, title, boundaries);
```

Run 009 Bow Thruster at 100% at 0-150° inc=30°

Order: 0, 30, 60, 90, 120, 150°

F_{sideFP} [N]

Mean:	-0.852056	-5.574809	-10.528523	-11.538542	-9.567151	-4.572430
Variance:	0.113158	0.725062	0.926493	0.041130	0.202755	0.854577
Max:	-0.077841	-3.322839	-8.851162	-10.738411	-8.673267	-2.807998
Min:	-1.551122	-7.530421	-12.328089	-12.145050	-10.325582	-6.415342

F_{sideAP} [N]

Mean:	0.293643	1.069925	1.597247	1.786045	1.463938	0.665127
Variance:	0.029225	0.119949	0.156365	0.014331	0.034266	0.126047
Max:	0.737056	1.873538	2.367223	2.250799	1.898973	1.390556
Min:	-0.242969	0.191742	0.821554	1.442992	0.919574	-0.087139

RPS_{Bow}

Mean:	32.561193	32.285433	32.057133	31.684229	31.615775	31.904315
Variance:	0.003280	0.003971	0.009132	0.001948	0.006874	0.002343
Max:	32.773919	32.453936	32.333343	31.820803	31.846013	32.033900
Min:	32.427910	32.113141	31.839424	31.571151	31.386644	31.757720

F_{Bow} [N]

Mean:	-4.227151	-4.120189	-2.381089	-0.031632	2.149440	3.818523
Variance:	0.010547	0.003666	0.001785	0.011464	0.001705	0.001476
Max:	-3.996599	-3.936704	-2.253032	0.201500	2.275992	3.896773
Min:	-4.510805	-4.301769	-2.496209	-0.301625	2.063362	3.714989

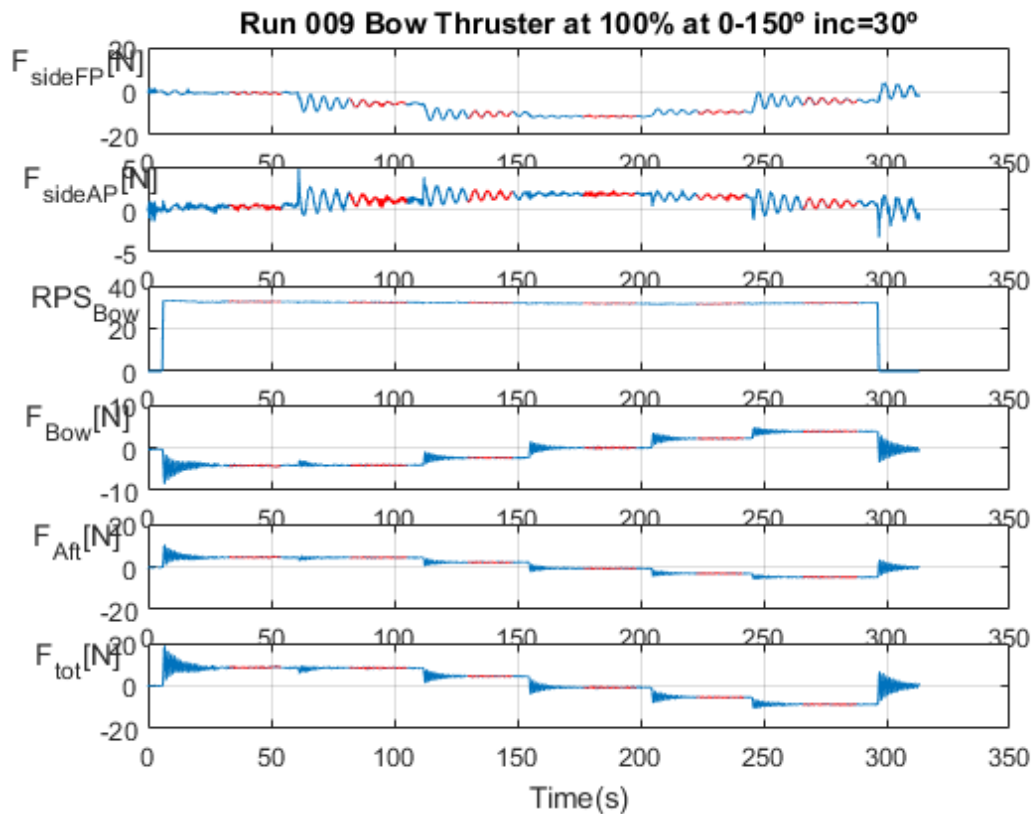
F_{Aft} [N]

Mean:	4.456319	4.311743	2.120358	-0.731539	-3.150244	-4.864388
Variance:	0.016354	0.005629	0.003026	0.014730	0.001962	0.001870
Max:	4.803989	4.544643	2.273256	-0.421375	-3.043739	-4.723349
Min:	4.180851	4.099856	1.957187	-0.988881	-3.282086	-4.954606

F_tot [N] F_aft-F_bow

Means:	8.683469	8.431931	4.501448	-0.699906	-5.299684	-8.682911
Variances:	0.053119	0.018020	0.008462	0.052116	0.007163	0.006395

Maxes:	9.313377	8.843359	4.726639	-0.124082	-5.108544	-8.440900
Minima:	8.180557	8.037378	4.243273	-1.188119	-5.555243	-8.843593



RUN 010 - Bow Thruster effort=100% angle=330,300,270,240,210,180

360 and 150° was omitted from test because of run 009

```

clc
title = 'Run 010 Bow Thruster at 100% at 330-180° inc=-30°';
disp(title)
disp('Order: 330, 300, 270, 240, 210, 180°')
disp(' ')
load 'num-run010-100-effort-360-150deg.mat';
display_data = {'time', 'force_bow', 'force_aft', 'rps_bow', ...
    'sideforce_ap','sideforce_fp'};
fs=200;
boundaries = {[44 73]*fs,[107 140]*fs,[180 236]*fs,[268 285]*fs, ...
    [320 359]*fs, [406 439]*fs};
filter_data_joined(num360_180, display_data, title, boundaries);

```

Run 010 Bow Thruster at 100% at 330-180° inc=-30°

Order: 330, 300, 270, 240, 210, 180°

F__{sideFP} [N]

Mean:	4.014396	9.124057	11.735329	10.413659	5.900583	-0.245603
Variance:	1.069846	0.365159	0.080371	0.186899	0.408030	0.050658
Max:	7.004519	10.487409	13.478993	11.209779	8.342740	0.213402
Min:	1.654910	7.801816	10.856264	9.594472	3.642668	-0.936318

F_{sideAP}[N]

Mean:	-0.642316	-1.320647	-1.751753	-1.621954	-0.955628	-0.007156
Variance:	0.149958	0.065620	0.033199	0.036573	0.077137	0.014094
Max:	0.553374	-0.552031	0.171502	-1.135631	1.407035	0.362841
Min:	-1.631286	-1.997889	-3.508362	-2.085476	-3.451941	-0.422531

RPS_{Bow}

Mean:	32.420968	32.580757	32.540710	32.493263	32.211343	31.871865
Variance:	0.001666	0.002394	0.001773	0.001004	0.012382	0.002174
Max:	32.551683	32.717282	32.666905	32.638615	32.388805	32.019448
Min:	32.292147	32.446817	32.406624	32.413399	31.930524	31.727883

F_{Bow}[N]

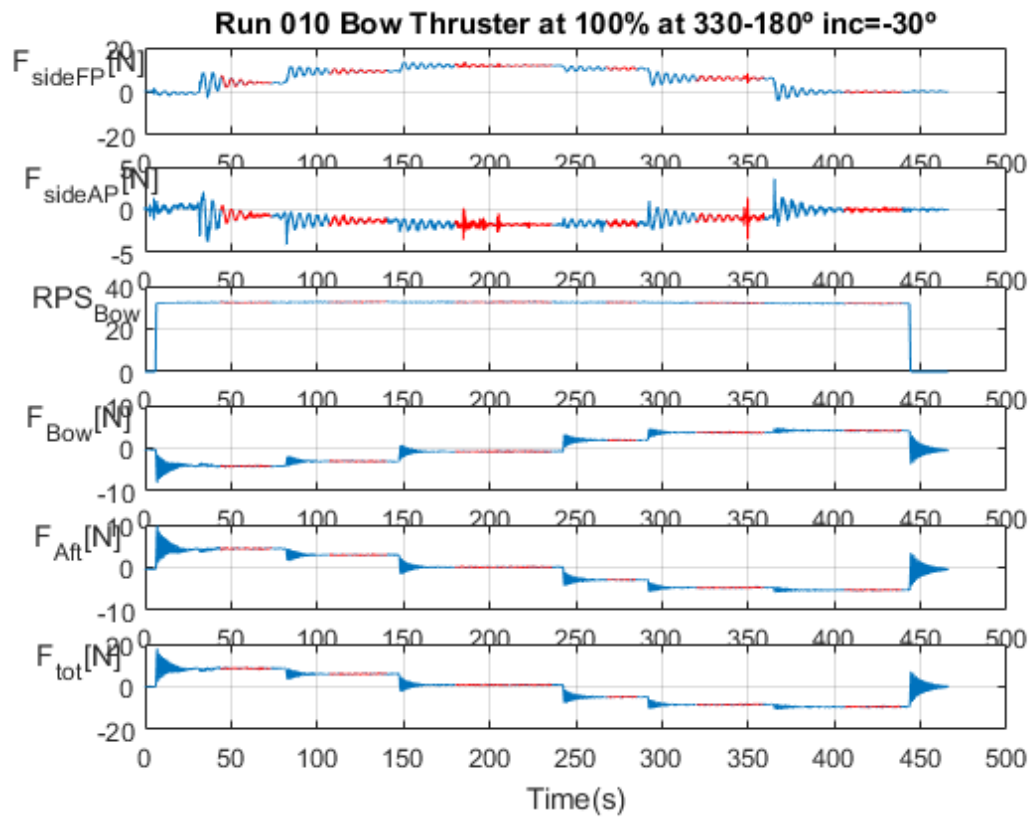
Mean:	-4.195779	-3.049042	-0.762041	1.892505	3.669655	4.094162
Variance:	0.005089	0.001810	0.001762	0.002071	0.002048	0.002517
Max:	-3.982224	-2.928657	-0.632849	1.999872	3.777281	4.216018
Min:	-4.386521	-3.164946	-0.902081	1.769872	3.525419	3.941096

F_{Aft}[N]

Mean:	4.405865	2.950673	0.101992	-2.883801	-4.728046	-5.277650
Variance:	0.007943	0.002553	0.002297	0.002243	0.002655	0.002205
Max:	4.633274	3.094108	0.259850	-2.773212	-4.561633	-5.140866
Min:	4.138308	2.823308	-0.041220	-3.015650	-4.844977	-5.403757

F_tot [N] F_aft-FBow

Means:	8.601645	5.999715	0.864034	-4.776307	-8.397701	-9.371812
Variances:	0.025700	0.008592	0.007863	0.008098	0.009223	0.008828
Maxes:	9.016800	6.254936	1.158824	-4.549356	-8.091031	-9.085176
Minima:	8.123858	5.755238	0.598710	-5.014158	-8.616702	-9.616614



**Run 011 - NEXT ONE IS NEWER - Resistance test at 0.5 knots with thruster(mounted)
effort=0%**

```
clc
title = 'Run 011 Resistance test at 0.5 knots with thruster effort=0%';
disp(title)
disp(' ')
load 'num0_5-run011.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed'};
fs=200;
boundaries = [116 142]*fs;
filter_data(num0_5, display_data, title, boundaries);
```

Run 011 Resistance test at 0.5 knots with thruster effort=0%

'F_{Bow} [N]'

Mean value: -0.062594

Variance: 0.427535

Max: 1.675536

Min: -1.610948

'F_{Aft} [N]'

Mean value: -0.325567

Variance: 0.538961

Max: 1.437405

Min: -2.267338

'Vessel Velocity [m/s]'

Mean value: 0.256967

Variance: 0.000001

Max: 0.259485

Min: 0.254404

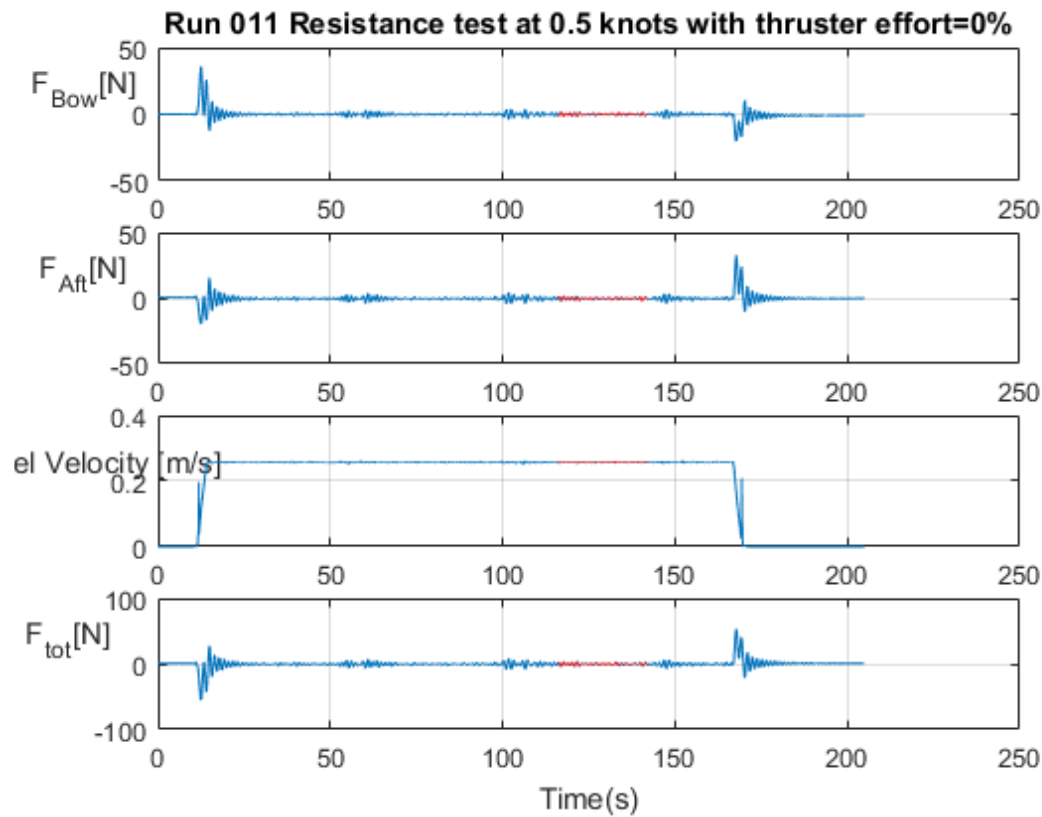
'F_tot [N] (F_aft-F_bow)'

Mean value: -0.262973

Variance: 1.926310

Max: 3.047535

Min: -3.941783



Run 012 - Resistance test at 0.5 knots with thruster(mounted) effort=0%

```
clc
title = 'Run 012(newer) Resistance test at 0.5 knots with thruster effort=0%';
disp(title)
disp(' ')
load 'num0_5-run012-newer.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed'};
fs=200;
boundaries = [181 246]*fs;
filter_data(num0_5, display_data, title, boundaries);
```

Run 012(newer) Resistance test at 0.5 knots with thruster effort=0%

'F_{Bow} [N] '

Mean value: 0.053957

Variance: 0.435968

Max: 2.235862

Min: -1.982003

'F_{Aft} [N] '

Mean value: -0.704556

Variance: 0.549915

Max: 1.627210

Min: -3.076736

'Vessel Velocity [m/s]'

Mean value: 0.256970

Variance: 0.000001

Max: 0.262685

Min: 0.253399

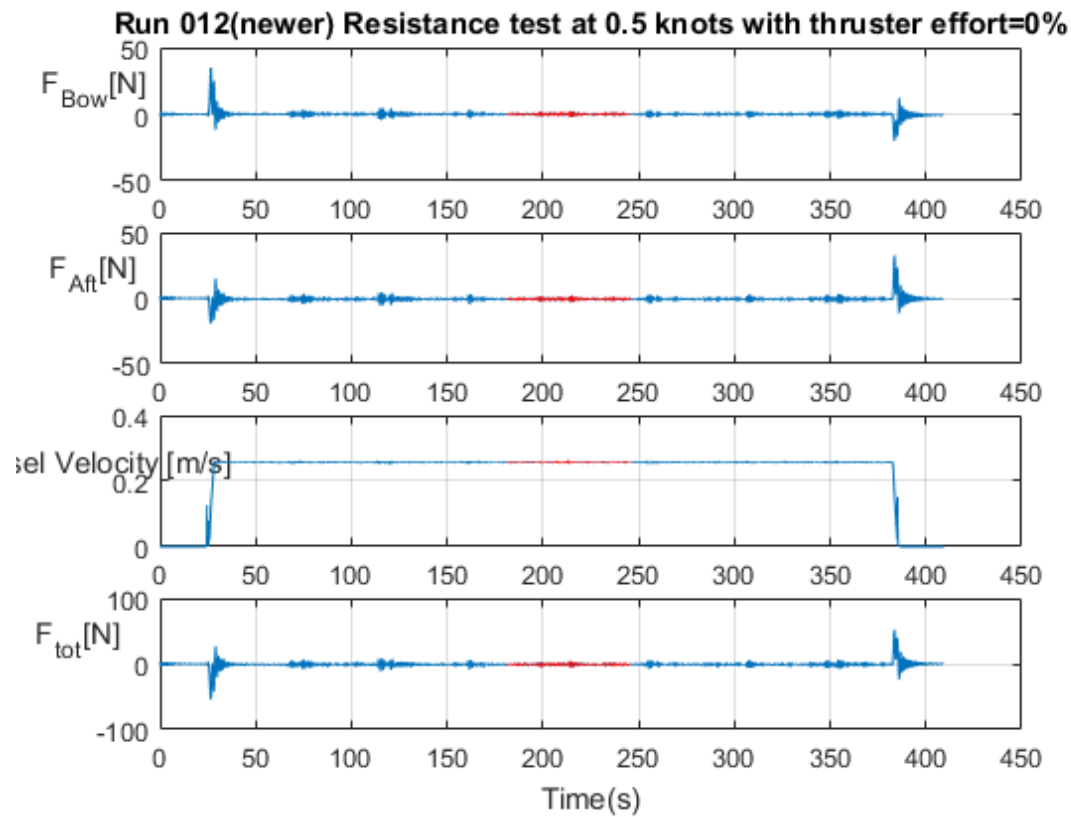
'F_tot [N] (F_aft-F_bow)'

Mean value: -0.758512

Variance: 1.963989

Max: 3.599929

Min: -5.312598



Run 013 - Resistance test at 1 knots with thrusters(mounted) effort=0%

```
clc
title = 'Run 013 Resistance test at 1 knots with thruster effort=0%';
disp(title)
disp(' ')
load 'num1-run013.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed'};
fs=200;
boundaries =[48 245]*fs;
filter_data(num1, display_data, title, boundaries);
```

Run 013 Resistance test at 1 knots with thruster effort=0%

'F_{Bow} [N] '

Mean value: 1.826350

Variance: 2.771234

Max: 6.099442

Min: -2.312329

'F_{Aft} [N] '

Mean value: -1.103225

Variance: 3.304118

Max: 3.704156

Min: -5.450390

'Vessel Velocity [m/s]'

Mean value: 0.514018

Variance: 0.000002

Max: 0.520929

Min: 0.507733

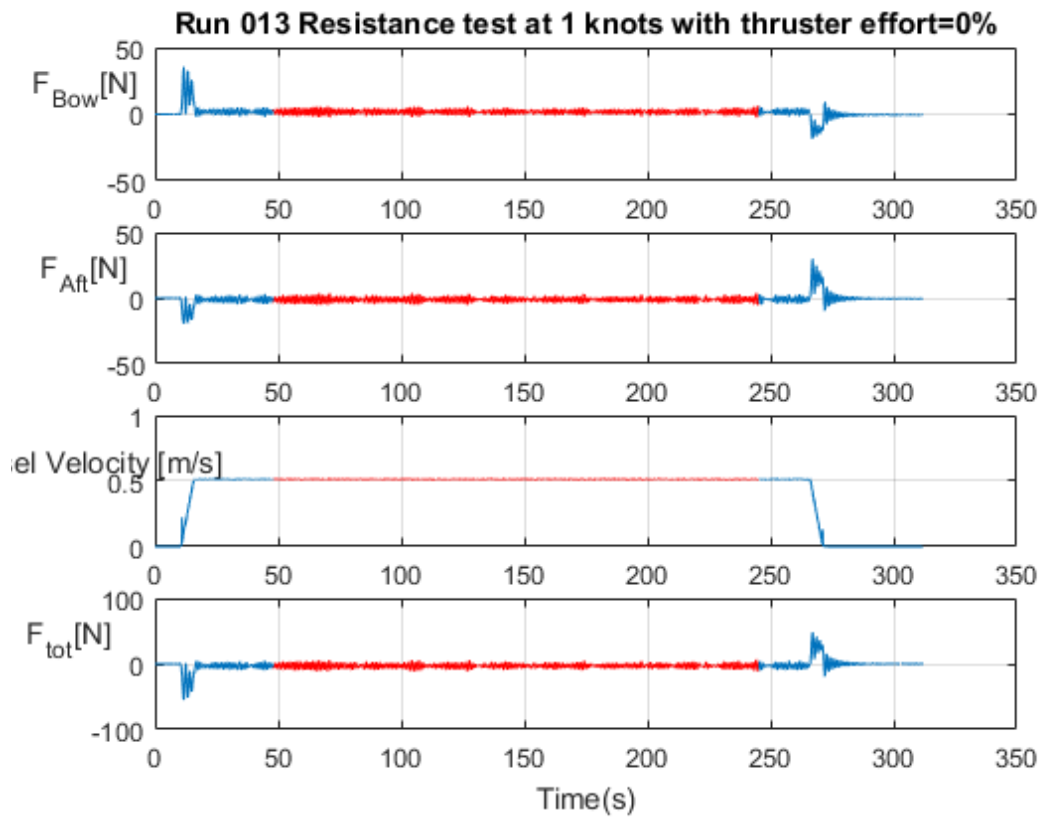
'F_tot [N] (F_aft-F_bow)'

Mean value: -2.929575

Variance: 12.123449

Max: 6.016485

Min: -11.545639



Run 014 - Resistance test at 1.34 knots with thrusters(mounted) effort=0%

```
clc
title = 'Run 014 Resistance test at 1.34 knots with thruster effort=0%';
disp(title)
disp(' ')
load 'num1_34-run014.mat';
display_data = {'time', 'force_bow', 'force_aft', 'speed'};
fs=200;
boundaries = [48 225]*fs;
filter_data(num1_34, display_data, title, boundaries);
```

Run 014 Resistance test at 1.34 knots with thruster effort=0%

'F_{Bow} [N] '

Mean value: 3.085780

Variance: 2.364071

Max: 8.434781

Min: -1.963435

'F_{Aft} [N] '

Mean value: -2.245795

Variance: 2.602534

Max: 3.373907

Min: -7.291989

'Vessel Velocity [m/s]'

Mean value: 0.689050

Variance: 0.000003

Max: 0.696920

Min: 0.680781

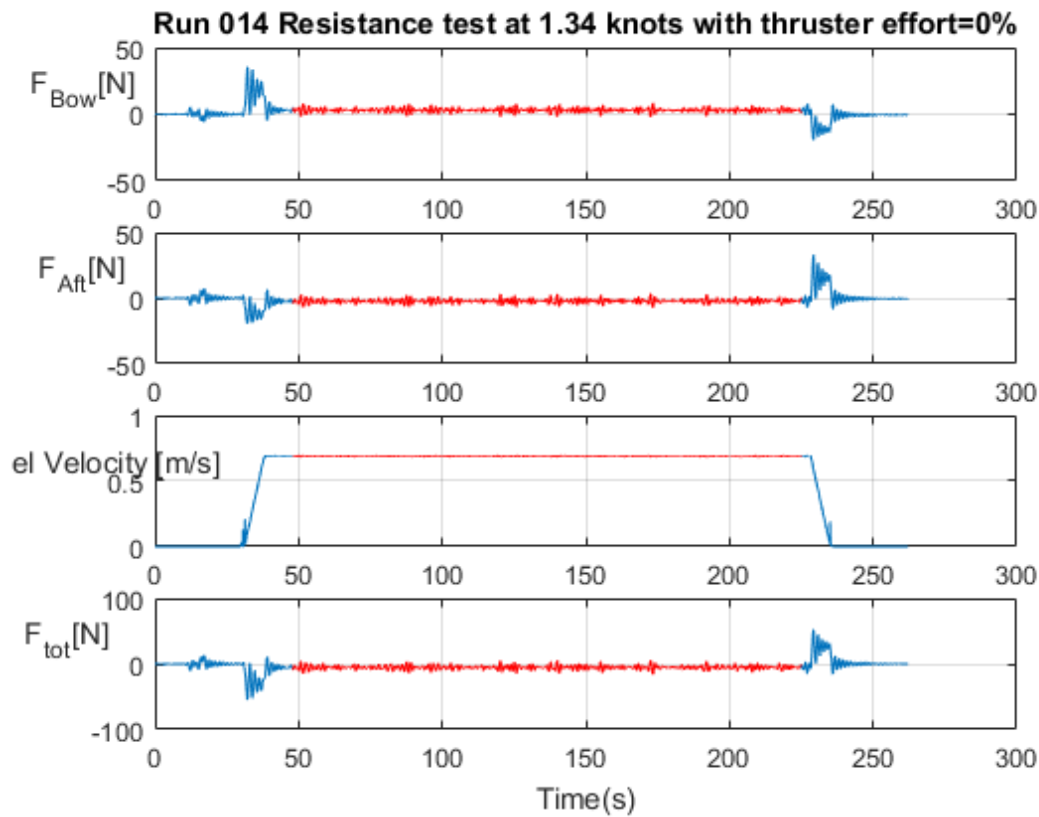
'F_tot [N] (F_aft-F_bow)'

Mean value: -5.331576

Variance: 9.918611

Max: 5.330534

Min: -15.721589



Run 015 - Resistance test at 3 knots with thrusters(mounted) effort=0%

```
clc
title = 'Run 015 Resistance test at 3 knots with thruster effort=0%';
disp(title)
disp(' ')
load 'num3-run015.mat';
display_data = {'time', 'force_bow', 'force_aft', 'speed'};
fs=200;
boundaries =[48 100]*fs;
filter_data(num3, display_data, title, boundaries);
```

Run 015 Resistance test at 3 knots with thruster effort=0%

'F_{Bow} [N] '

Mean value: 19.464190

Variance: 11.173668

Max: 27.510107

Min: 10.090302

'F_{Aft} [N] '

Mean value: -11.682910

Variance: 4.365836

Max: -5.443027

Min: -15.967659

'Vessel Velocity [m/s]'

Mean value: 1.543253

Variance: 0.000006

Max: 1.553840

Min: 1.532859

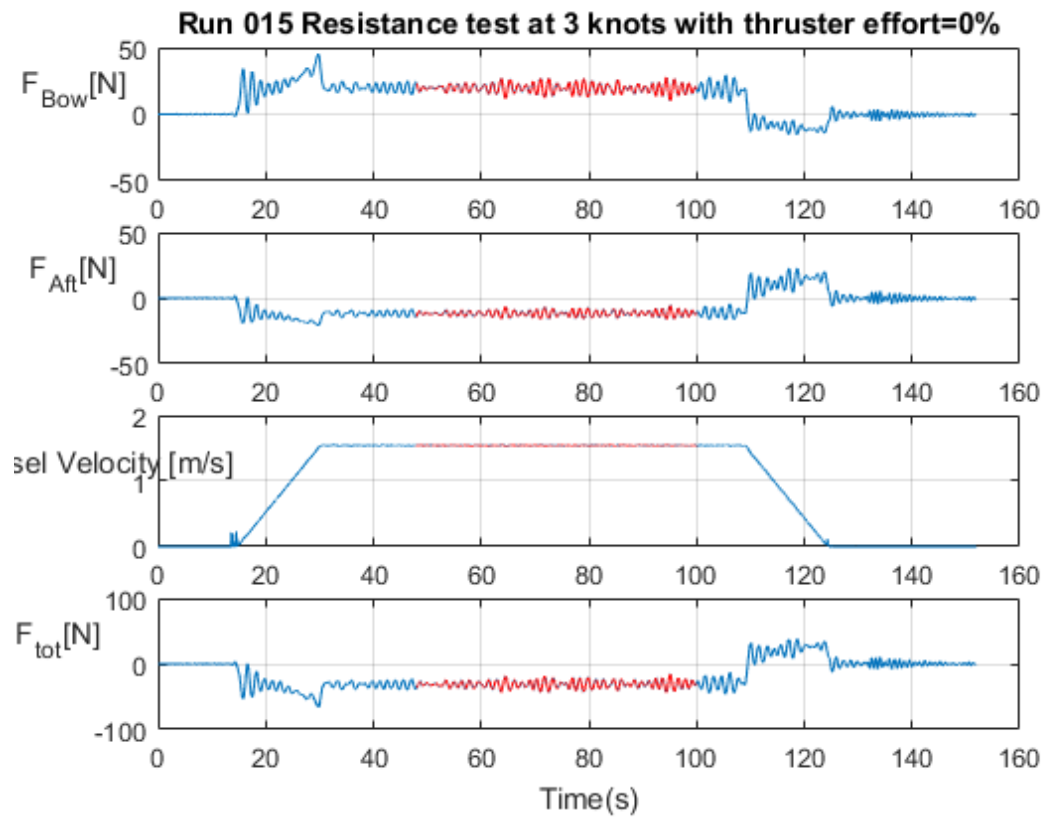
'F_tot [N] (F_aft-F_bow)'

Mean value: -31.147100

Variance: 29.435892

Max: -15.533329

Min: -43.471178



Run 016 - Resistance test at 4 knots with thrusters(mounted) effort=0%

```
clc
title = 'Run 016 Resistance test at 4 knots with thruster effort=0%';
disp(title)
disp(' ')

load 'num4-run016.mat';
display_data = {'time', 'force_bow', 'force_aft', 'speed'};
fs=200;
boundaries =[40 80]*fs;
filter_data(num4, display_data, title, boundaries);
```

Run 016 Resistance test at 4 knots with thruster effort=0%

'F_{Bow} [N] '

Mean value: 72.154557

Variance: 18.916802

Max: 83.972413

Min: 60.866696

'F_{Aft} [N] '

Mean value: -21.801165

Variance: 0.401457

Max: -19.968291

Min: -23.383417

'Vessel Velocity [m/s]'

Mean value: 2.058315

Variance: 0.000006

Max: 2.068530

Min: 2.046766

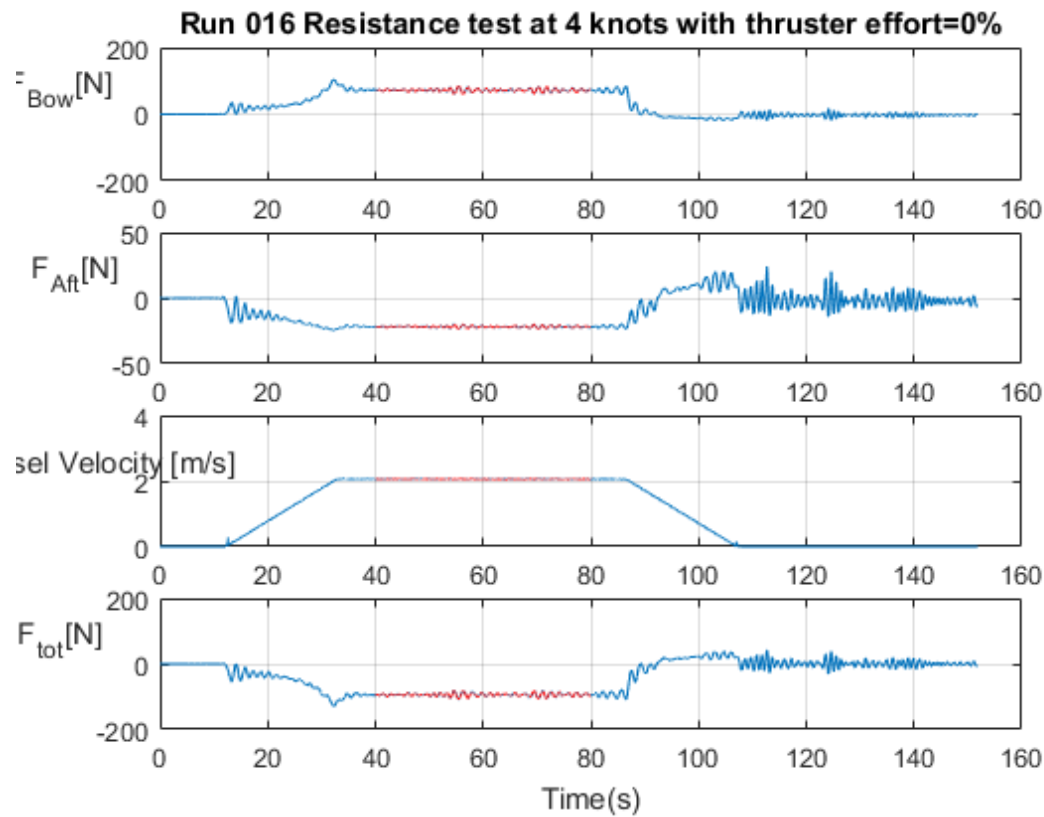
'F_tot [N] (F_aft-F_bow)'

Mean value: -93.955722

Variance: 24.772697

Max: -80.896346

Min: -107.347921



Run 017 Resistance test at 1.34 knots with thruster effort=100,75%

```
clc
title = 'Run 017 Resistance test at 1.34 knots with thrusters at 100 and 75%, respective
ly';
disp(title)
disp(' ')
fs=200;
boundaries = {[50 90]*fs,[116 226]*fs];
load 'num75_100-run017.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed', 'rps_star', 'rps_port'};

filter_data_joined(num100_75, display_data, title, boundaries);
```

Run 017 Resistance test at 1.34 knots with thrusters at 100 and 75%, respectively

```
RPS_{star}[RPS]
Mean:      12.487582  11.675335
Variance:  0.013716  0.013577
Max:       12.774360  11.995607
Min:       12.057452  11.228509
```

```
RPS_{port}
Mean:      11.862093  10.212117
Variance:  0.023329  0.020409
Max:       12.406091  10.710713
```

Min: 11.477614 9.743491

F_{Bow} [N]

Mean: -12.772848 -10.330476

Variance: 1.204269 1.008668

Max: -9.548644 -7.448696

Min: -16.281534 -13.535610

F_{Aft} [N]

Mean: 17.265924 12.759033

Variance: 3.849544 2.536288

Max: 24.288727 18.313415

Min: 11.493524 8.157756

Vessel Velocity [m/s]

Mean: 0.689054 0.689036

Variance: 0.000002 0.000003

Max: 0.694961 0.695864

Min: 0.683190 0.681663

F_{tot} [N] F_{aft}-F_{bow}

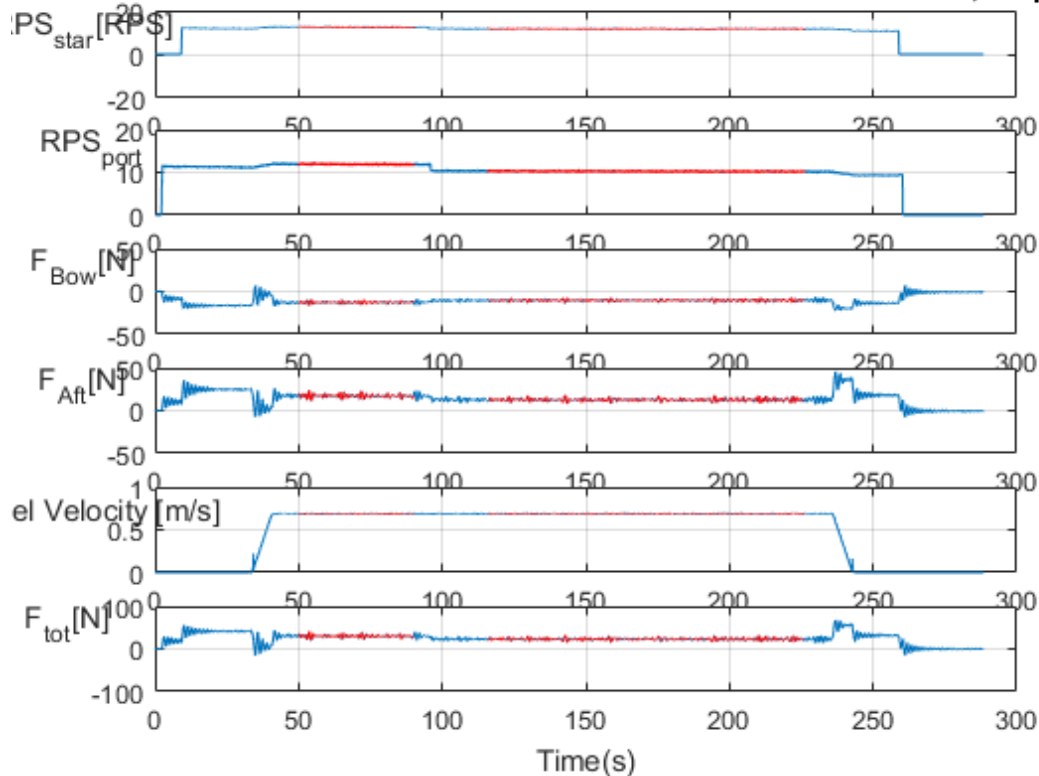
Means: 30.038771 23.089509

Variances: 9.346014 6.735611

Maxes: 40.558282 31.844233

Minima: 21.044564 15.621955

Run 017 Resistance test at 1.34 knots with thrusters at 100 and 75%, respectiv



Run 018 Resistance test at 1.34 knots with thruster effort=50,25%

```
clc
title = 'Run 018 Resistance test at 1.34 knots with thrusters at 50 and 25%, respectively';
disp(title)
disp(' ')
fs=200;
boundaries = {[50 100]*fs,[150 226]*fs};
load 'num50_25-run018.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed', 'rps_star', 'rps_port'};
filter_data_joined(num50_25, display_data, title, boundaries);
```

Run 018 Resistance test at 1.34 knots with thrusters at 50 and 25%, respectively

RPS_{star}[RPS]

Mean:	9.280316	5.767276
Variance:	0.008273	0.008469
Max:	9.530303	5.996031
Min:	8.908392	5.384991

RPS_{port}

Mean:	7.520794	3.853093
Variance:	0.014862	0.016851
Max:	7.899329	4.222802
Min:	7.142095	3.496722

F_{Bow}[N]

Mean:	-4.781558	0.266109
Variance:	1.576426	1.462602
Max:	-0.459451	3.827593
Min:	-9.282706	-3.838774

F_{Aft}[N]

Mean:	5.332843	-0.448108
Variance:	2.671019	1.747184
Max:	11.599881	4.265936
Min:	-0.053764	-4.171933

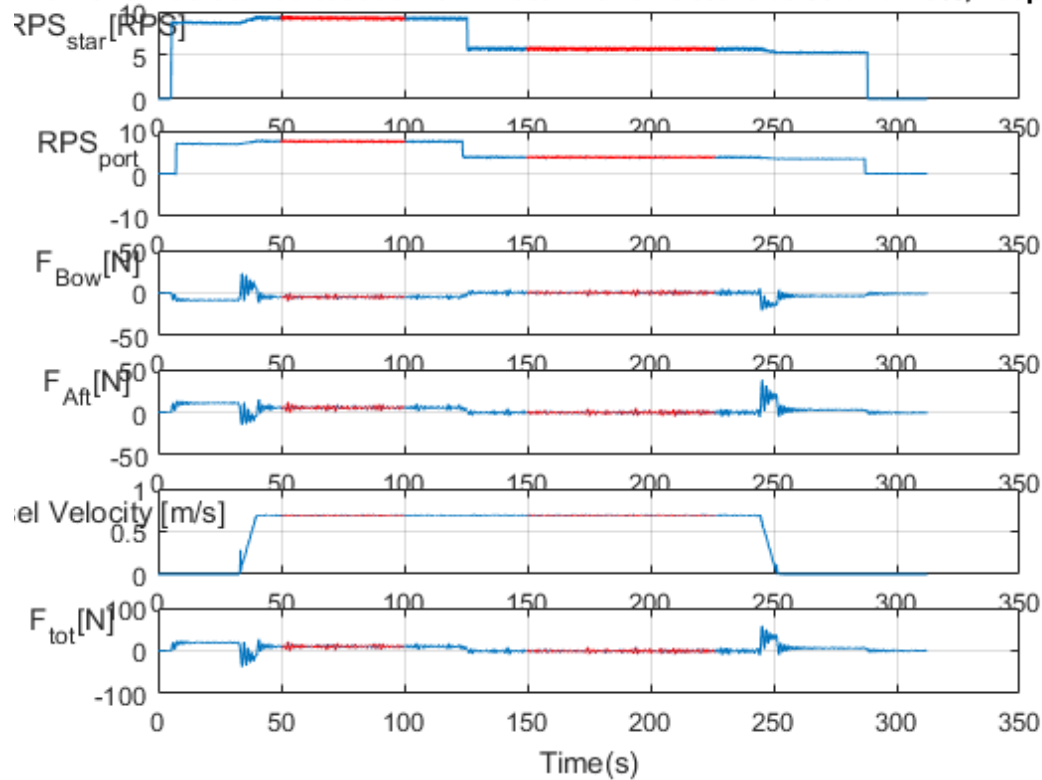
Vessel Velocity [m/s]

Mean:	0.689089	0.689031
Variance:	0.000003	0.000003
Max:	0.695773	0.696561
Min:	0.682745	0.682256

F_tot [N] F_aft-F_bow

Means:	10.114401	-0.714217
Variances:	8.346672	6.403967
Maxes:	20.873004	8.104709
Minima:	0.418504	-7.999527

Run 018 Resistance test at 1.34 knots with thrusters at 50 and 25%, respective



Run 019 Resistance test at 1 knots with thruster effort=100,75%

```
clc
title = 'Run 019 Resistance test at 1 knots with thrusters at 100 and 75%';
disp(title)
disp(' ')
load 'num100_75-run019.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed', 'rps_star', 'rps_port'};
fs=200;
boundaries = {[50 140]*fs,[175 275]*fs};
filter_data_joined(num100_75, display_data, title, boundaries);
```

Run 019 Resistance test at 1 knots with thrusters at 100 and 75%

```
RPS_{star}[RPS]
Mean:      12.072744  11.212683
Variance:  0.020012  0.016396
Max:       12.430171  11.545007
Min:       11.590762  10.791484
```

```
RPS_{port}
Mean:      11.438921  9.819481
Variance:  0.023874  0.017284
Max:       11.922020  10.267910
```

Min: 11.021913 9.435601

F_{Bow} [N]

Mean: -13.203930 -10.788024

Variance: 1.894263 1.801880

Max: -10.069139 -7.051287

Min: -16.876300 -15.016534

F_{Aft} [N]

Mean: 18.739936 13.958652

Variance: 6.453702 4.934904

Max: 26.440123 22.143330

Min: 12.850248 7.910410

Vessel Velocity [m/s]

Mean: 0.514036 0.514015

Variance: 0.000002 0.000002

Max: 0.520981 0.521117

Min: 0.506687 0.507228

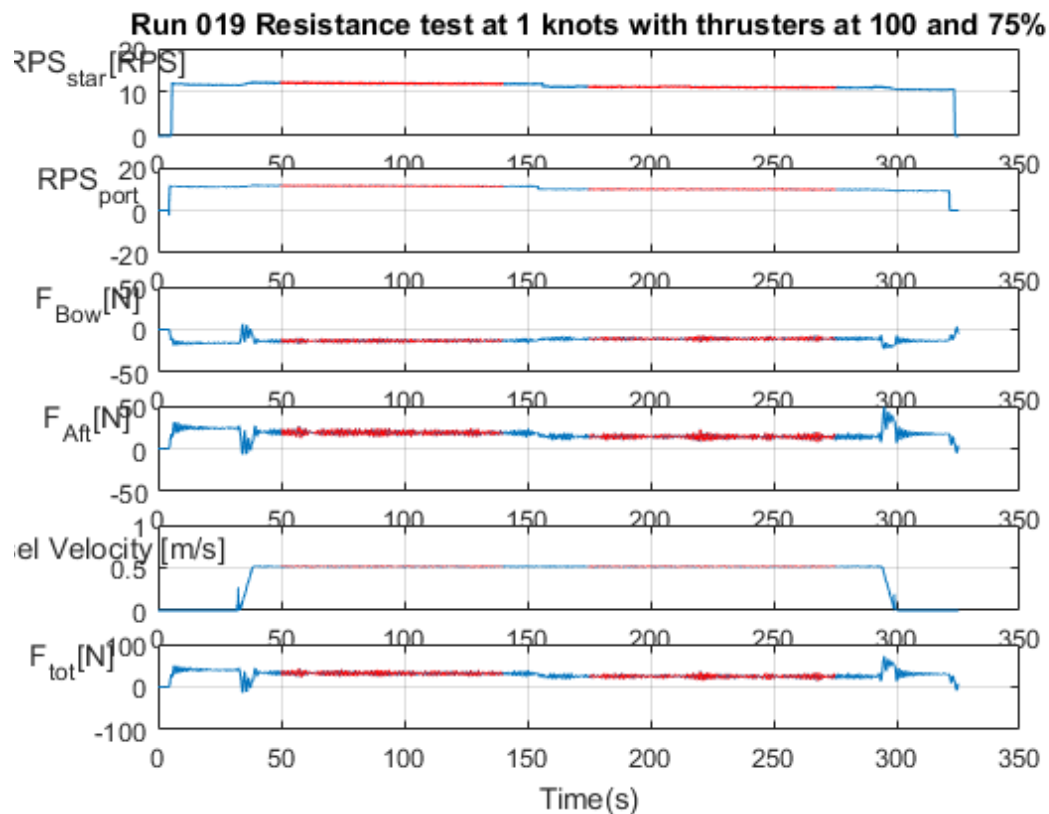
F_{tot} [N] F_{aft}-F_{bow}

Means: 31.943866 24.746676

Variances: 15.326036 12.687983

Maxes: 43.313129 37.159565

Minima: 22.942447 14.978168



Run 022 Resistance test at 1 knots with thruster effort=50,25%

```
clc
title = 'Run 022 Resistance test at 1 knots with thrusters at 50 and 25%';
disp(title)
disp(' ')

load 'num50_25-run022.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed', 'rps_star', 'rps_port'};
fs=200;
boundaries = {[50 140]*fs, [175 275]*fs};
filter_data_joined(num50_25, display_data, title, boundaries);
```

Run 022 Resistance test at 1 knots with thrusters at 50 and 25%

RPS_{star}[RPS]

Mean:	9.337964	5.804597
Variance:	0.006633	0.006066
Max:	9.549800	6.026156
Min:	9.013369	5.513765

RPS_{port}

Mean:	7.501321	3.811179
Variance:	0.027182	0.016892
Max:	7.978371	4.208591
Min:	7.131693	3.471136

F_{Bow}[N]

Mean:	-6.064767	-0.850616
Variance:	2.408076	2.952520
Max:	-2.862771	4.066877
Min:	-9.276118	-5.348448

F_{Aft}[N]

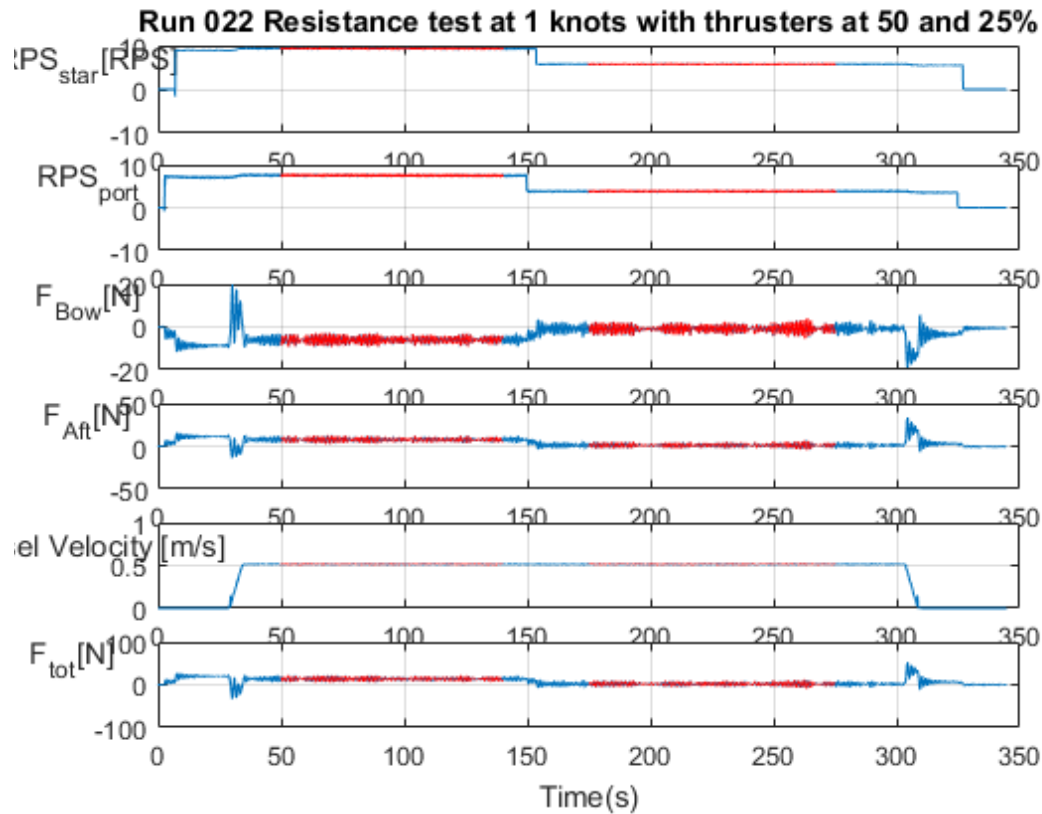
Mean:	7.645340	1.124815
Variance:	4.583344	3.840072
Max:	12.238836	6.575775
Min:	3.363271	-3.981037

Vessel Velocity [m/s]

Mean:	0.514024	0.514021
Variance:	0.000002	0.000002
Max:	0.519818	0.520255
Min:	0.507418	0.508048

F_tot [N] F_aft-F_bow

Means:	13.710107	1.975430
Variances:	13.629845	13.521451
Maxes:	21.512772	11.921224
Minima:	6.248565	-8.038642



Run 020 Resistance test at 3 knots with thruster effort=100%

```
clc
title = 'Run 020 Resistance test at 3 knots with thrusters at 100%';
disp(title)
disp(' ')

load 'num100-run020.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed', 'rps_star', 'rps_port'};
fs=200;
boundaries = [40 100]*fs;
filter_data(num100, display_data, title, boundaries);
```

Run 020 Resistance test at 3 knots with thrusters at 100%

'RPS_{star}'

Mean value: 13.710040

Variance: 0.066696

Max: 14.290385

Min: 12.864275

'RPS_{port}'

Mean value: 12.143849

Variance: 0.605119

Max: 13.886069

Min: 10.701651

'F_{Bow} [N]'

Mean value: 3.045072

Variance: 7.037366

Max: 9.472776

Min: -4.424855

'F_{Aft} [N]'

Mean value: -1.576458

Variance: 6.991811

Max: 6.615863

Min: -7.219721

'Vessel Velocity [m/s]'

Mean value: 1.543217

Variance: 0.000006

Max: 1.555300

Min: 1.533705

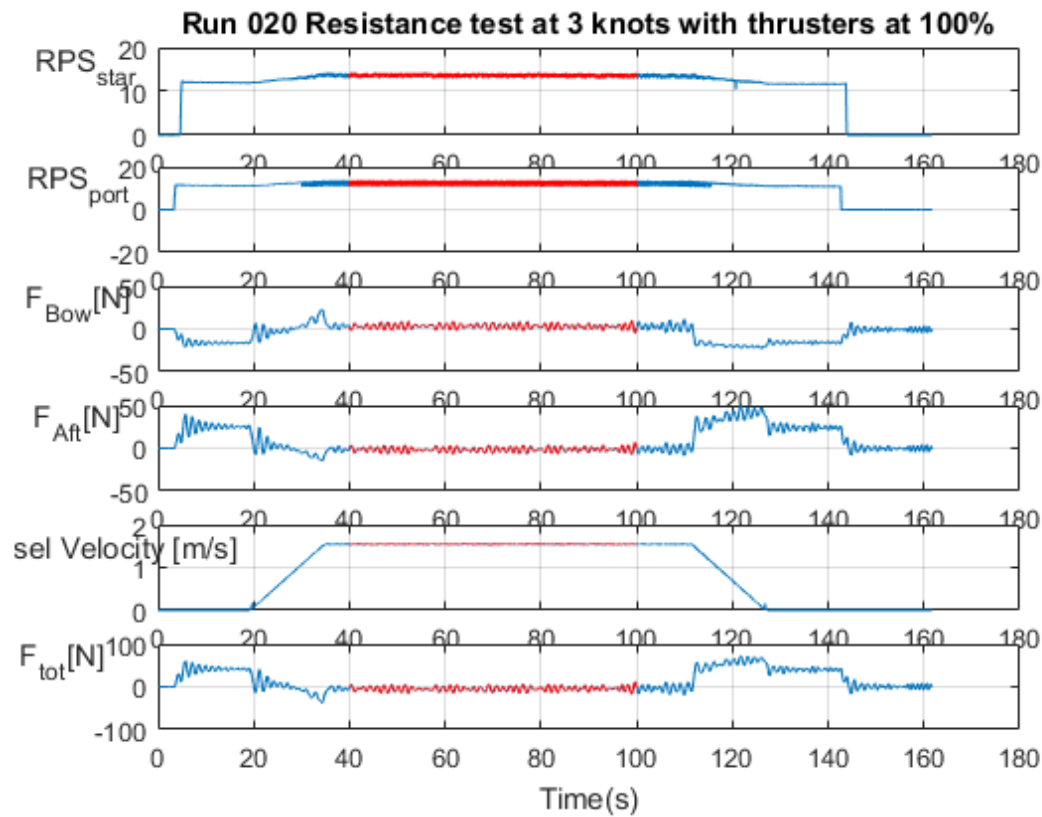
'F_tot [N] (F_aft-F_bow)'

Mean value: -4.621531

Variance: 28.032390

Max: 11.036359

Min: -16.679588



Run 021 Resistance test at 3 knots with thruster effort=75%

```
clc
title = 'Run 021 Resistance test at 3 knots with thrusters at 75%';
disp(title)
disp(' ')

load 'num75-run021.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed', 'rps_star', 'rps_port'};
fs=200;
boundaries = [40 100]*fs;
filter_data(num75, display_data, title, boundaries);
```

Run 021 Resistance test at 3 knots with thrusters at 75%

'RPS_{star}'

Mean value: 12.989696

Variance: 0.164890

Max: 13.673937

Min: 11.007495

'RPS_{port}'

Mean value: 11.535205

Variance: 0.094383

Max: 12.304170

Min: 10.805331

'F_{Bow} [N]'

Mean value: 5.280148

Variance: 7.025634

Max: 11.476890

Min: -1.403110

'F_{Aft} [N]'

Mean value: -3.161120

Variance: 6.019710

Max: 3.451628

Min: -8.182927

'Vessel Velocity [m/s]'

Mean value: 1.543199

Variance: 0.000005

Max: 1.553510

Min: 1.531785

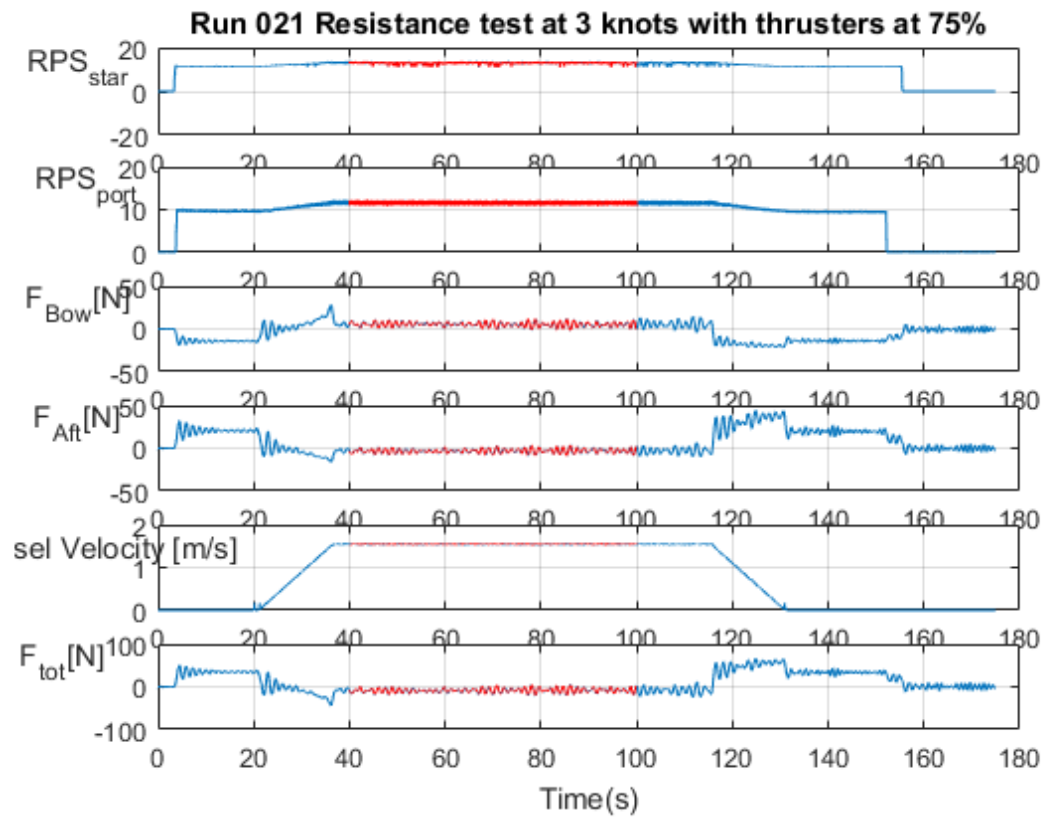
'F_tot [N] (F_aft-F_bow)'

Mean value: -8.441268

Variance: 26.022388

Max: 4.850648

Min: -19.654476



Run 023 Resistance test at 3 knots with thruster effort=100,75,50,25%

```
clc
title = 'Run 023 Resistance test at 3 knots with thrusters at 100,75,50 25%, respectively';
disp(title)
disp(' ')

load 'num100_25-run023.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed', 'rps_star', 'rps_port'};
fs=200;
boundaries = {[48 145]*fs, [195 287]*fs, [331 429]*fs, [466 563]*fs];
filter_data_joined(num100_25, display_data, title, boundaries);
```

Run 023 Resistance test at 3 knots with thrusters at 100,75,50 25%, respectively

```
RPS_{star}[RPS]
Mean:      12.100759  11.310142  8.875055  5.562482
Variance:  0.013661  0.013763  0.006637  0.005069
Max:       12.414000  11.635138  9.124025  5.766120
Min:       11.715696  10.965337  8.605117  5.267224

RPS_{port}
Mean:      11.246052  9.743651  7.138156  3.646662
Variance:  0.040331  0.032583  0.019904  0.008641
Max:       11.798638  10.207125  7.581720  3.968919
```

Min: 10.766323 9.352567 6.768272 3.384005

F_{Bow} [N]

Mean: -14.797427 -12.633805 -7.921288 -2.915122
Variance: 0.603374 0.423051 0.613519 0.865531
Max: -11.594386 -10.590532 -5.402055 1.569521
Min: -17.264425 -14.915011 -10.797472 -7.385805

F_{Aft} [N]

Mean: 21.478313 16.655973 8.141661 1.628296
Variance: 2.366824 1.241634 1.264793 1.229353
Max: 26.904272 20.925688 12.618174 7.499984
Min: 15.172360 13.131138 4.563733 -3.271723

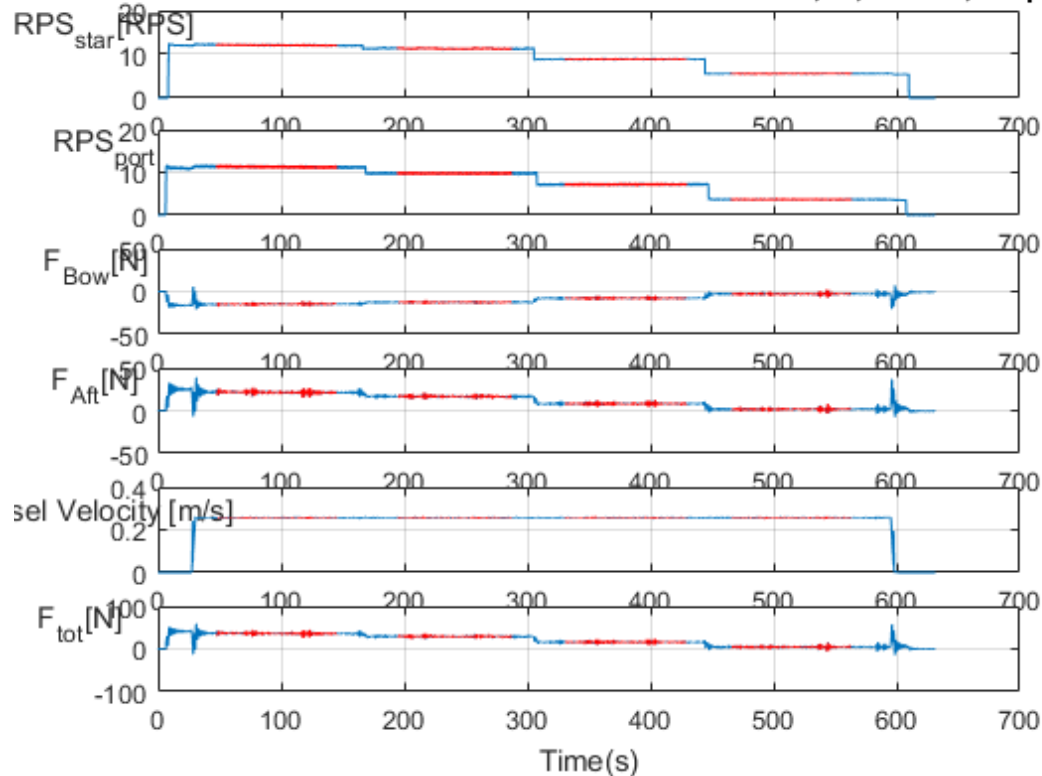
Vessel Velocity [m/s]

Mean: 0.256986 0.256967 0.256961 0.256946
Variance: 0.000001 0.000001 0.000001 0.000001
Max: 0.261749 0.262925 0.261847 0.261265
Min: 0.251305 0.252856 0.253579 0.250426

F_{tot} [N] F_{aft}-F_{bow}

Means: 36.275740 29.289779 16.062949 4.543418
Variances: 5.351963 3.110341 3.637343 4.153213
Maxes: 44.167799 35.837426 23.415646 14.885789
Minima: 26.768543 23.762951 9.965788 -4.841243

Run 023 Resistance test at 3 knots with thrusters at 100,75,50 25%, respective



RUN 24-26 NONE

RUN 027 Resistance test at 3 knots with thrusters UNMOUNTED

```
clc
title = 'Run 027 Resistance test at 3 knots with thrusters unmounted';
disp(title)
disp(' ')
load 'num3-run027.mat'
display_data = {'time', 'force_bow', 'force_aft', 'speed', 'sideforce_ap', 'sideforce_fp'};
fs=200;
boundaries = [50 100]*fs;
filter_data(num3, display_data, title, boundaries);
```

Run 027 Resistance test at 3 knots with thrusters unmounted

'F_{sideFP}[N]'

Mean value: 0.958755

Variance: 1.995702

Max: 9.204768

Min: -9.683693

'F_{sideAP}[N]'

Mean value: -1.966126

Variance: 3.488474

Max: 16.495826

Min: -17.562901

'F_{Bow}[N]'

Mean value: 17.218595

Variance: 11.675313

Max: 25.636865

Min: 9.099924

'F_{Aft}[N]'

Mean value: -10.042777

Variance: 4.367713

Max: -4.833523

Min: -14.340136

'Vessel Velocity [m/s]'

Mean value: 1.543214

Variance: 0.000006

Max: 1.553301

Min: 1.535034

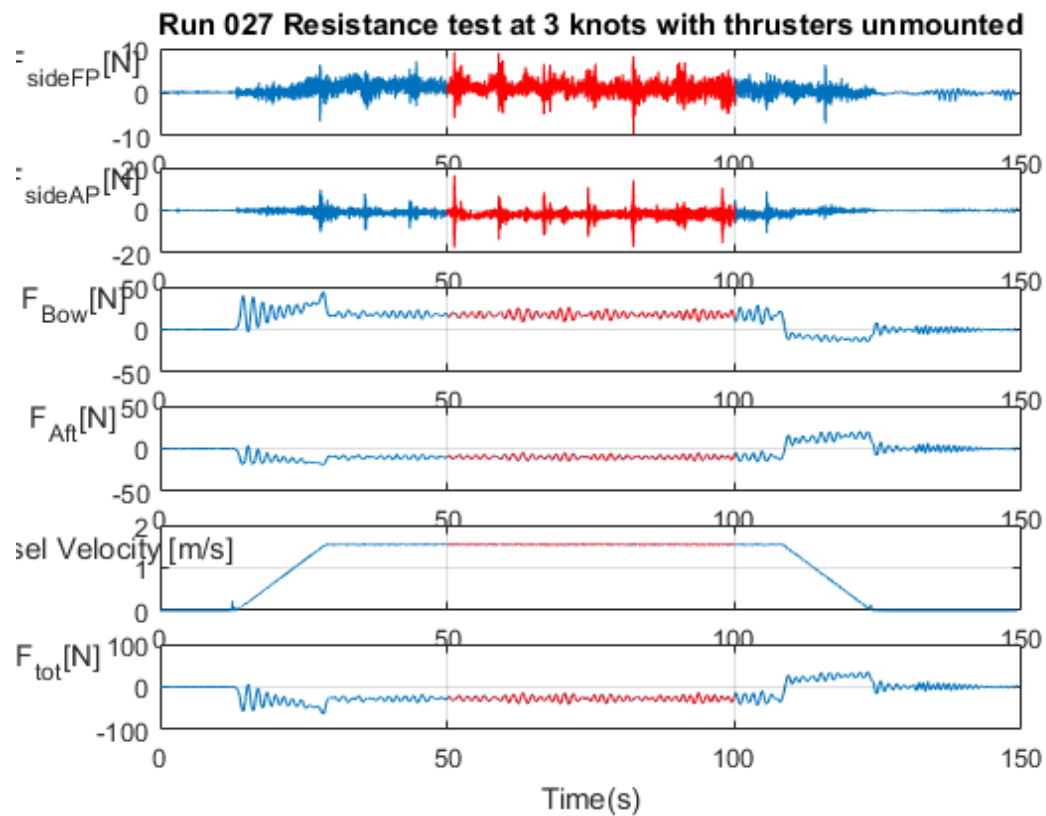
'F_tot [N] (F_aft-F_bow)'

Mean value: -27.261372

Variance: 30.232699

Max: -13.956083

Min: -39.975204



RUN 028 Resistance test at 4 knots with thrusters UNMOUNTED

```
clc
title = 'Run 028 Resistance test at 4 knots with thrusters unmounted';
disp(title)
disp(' ')
load 'num4-run028.mat';
display_data = {'time', 'force_bow', 'force_aft', 'speed', 'sideforce_ap', 'sideforce_fp'};
fs=200;
boundaries = [50 90]*fs;
filter_data(num4, display_data, title, boundaries);
```

Run 028 Resistance test at 4 knots with thrusters unmounted

'F_{sideFP}[N]'

Mean value: 1.718100

Variance: 5.626272

Max: 12.142046

Min: -7.578172

'F_{sideAP}[N]'

Mean value: -3.499819

Variance: 6.021149

Max: 16.510603

Min: -19.932766

'F_{Bow}[N]'

Mean value: 68.859232

Variance: 14.274926

Max: 77.615069

Min: 59.906865

'F_{Aft}[N]'

Mean value: -19.202016

Variance: 0.417689

Max: -17.533005

Min: -20.589247

'Vessel Velocity [m/s]'

Mean value: 2.058310

Variance: 0.000005

Max: 2.068642

Min: 2.046758

'F_tot [N] (F_aft-F_bow)'

Mean value: -88.061248

Variance: 19.519558

Max: -77.452688

Min: -98.149659

