ASEN 6080 HW 2 Problem 1 Main Script

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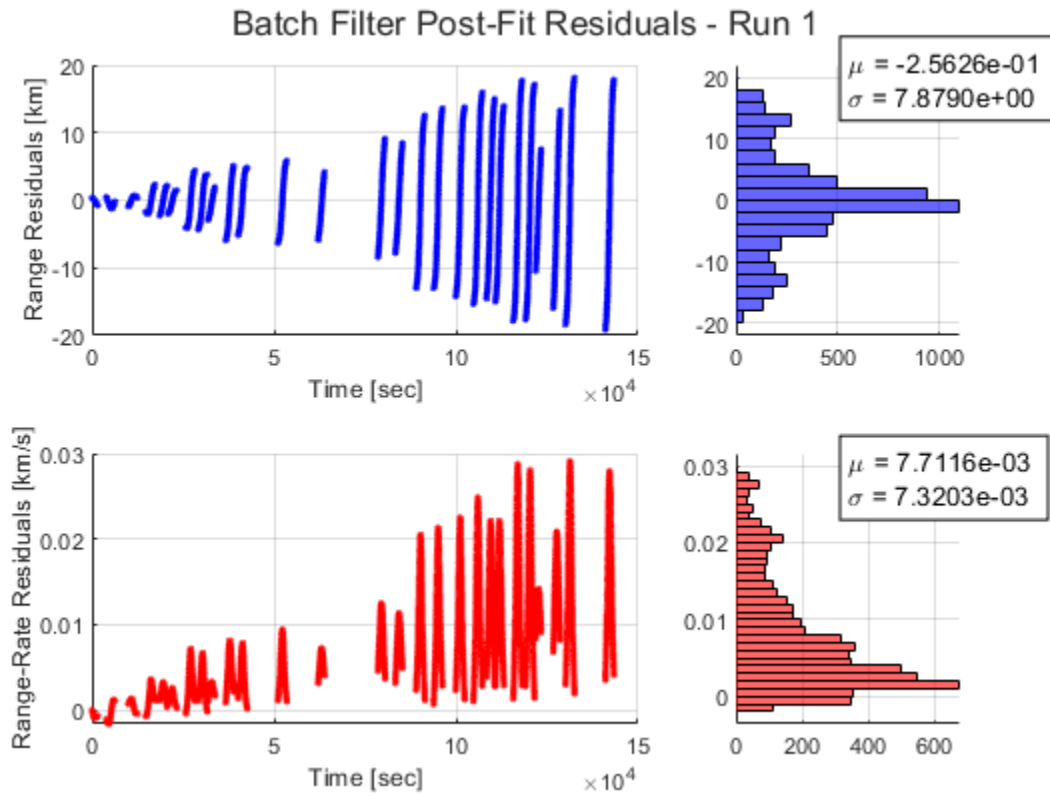
By: Ian Faber

Housekeeping

Setup

Make Truth Data

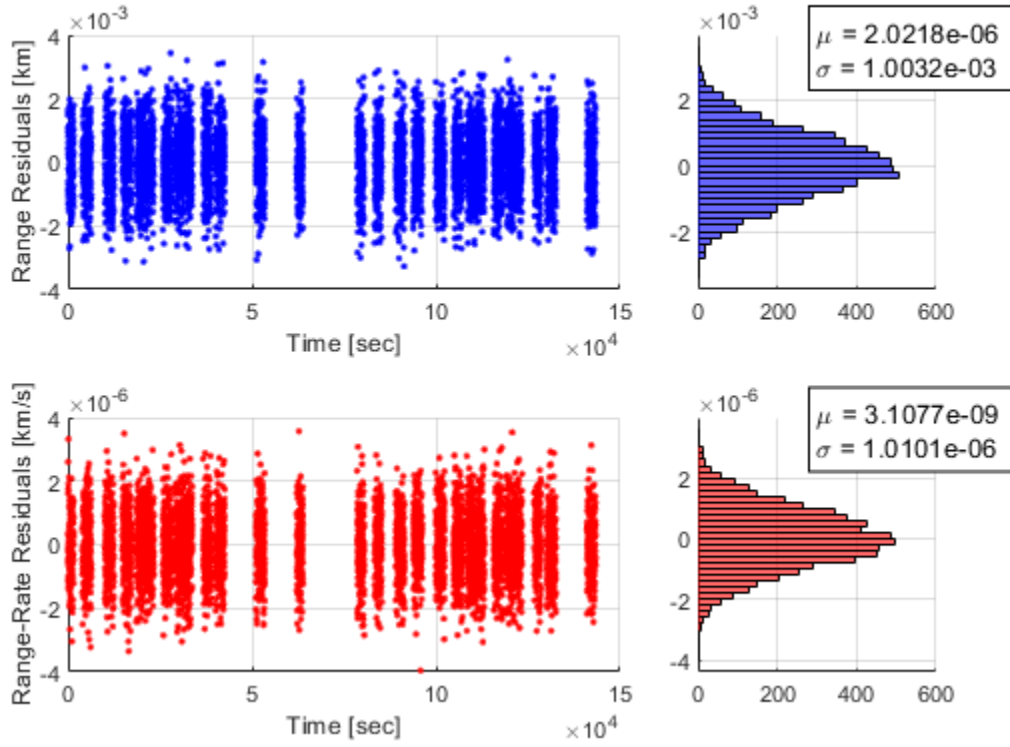# Problem 1a: Filter setup

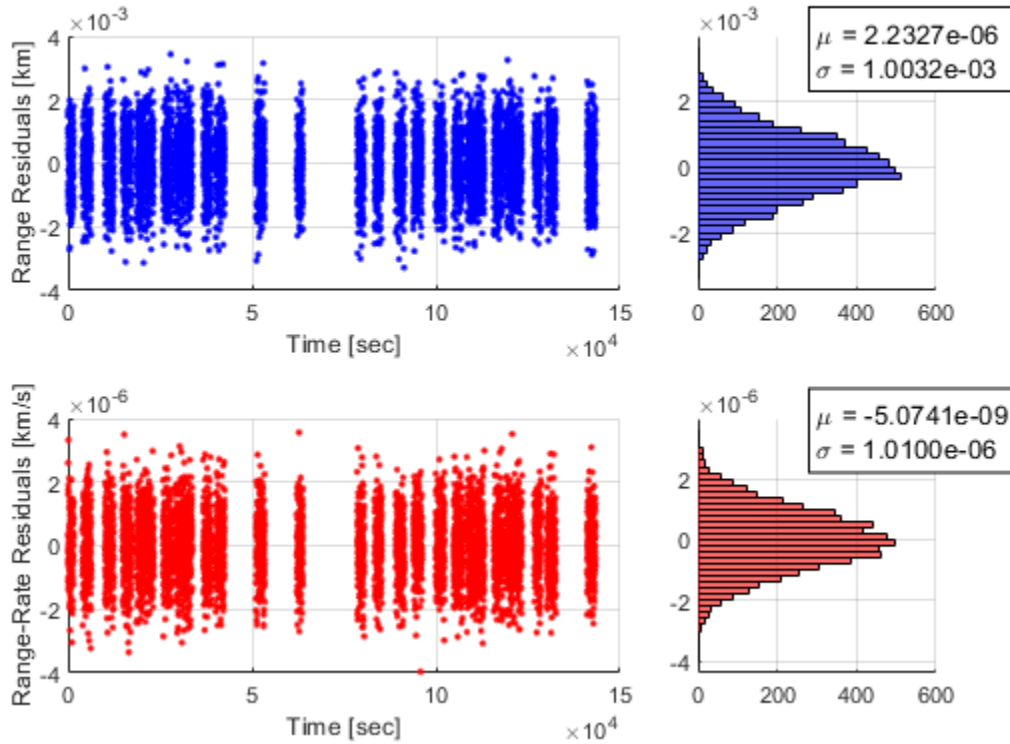# Problem 1b: Batch Filter

1b. Batch Filter

```
    Running Batch Filter:
Postfit RMS: 25.7449. Iterating Batch with x0_batch = [1.067e-02;
-4.072e-03; 1.021e-02; 1.778e-05; -4.425e-06; 2.383e-05]. Runs so far: 1
Postfit RMS: 1.0065. Iterating Batch with x0_batch = [-2.875e-05; 2.892e-06;
-2.544e-05; -1.682e-08; -1.178e-09; -2.762e-08]. Runs so far: 2
Postfit RMS: 1.0065. Iterating Batch with x0_batch = [-2.879e-05; 2.845e-06;
-2.535e-05; -1.693e-08; -1.208e-09; -2.768e-08]. Runs so far: 3
Final postfit RMS: 1.0065. Converged after 4 runs
```
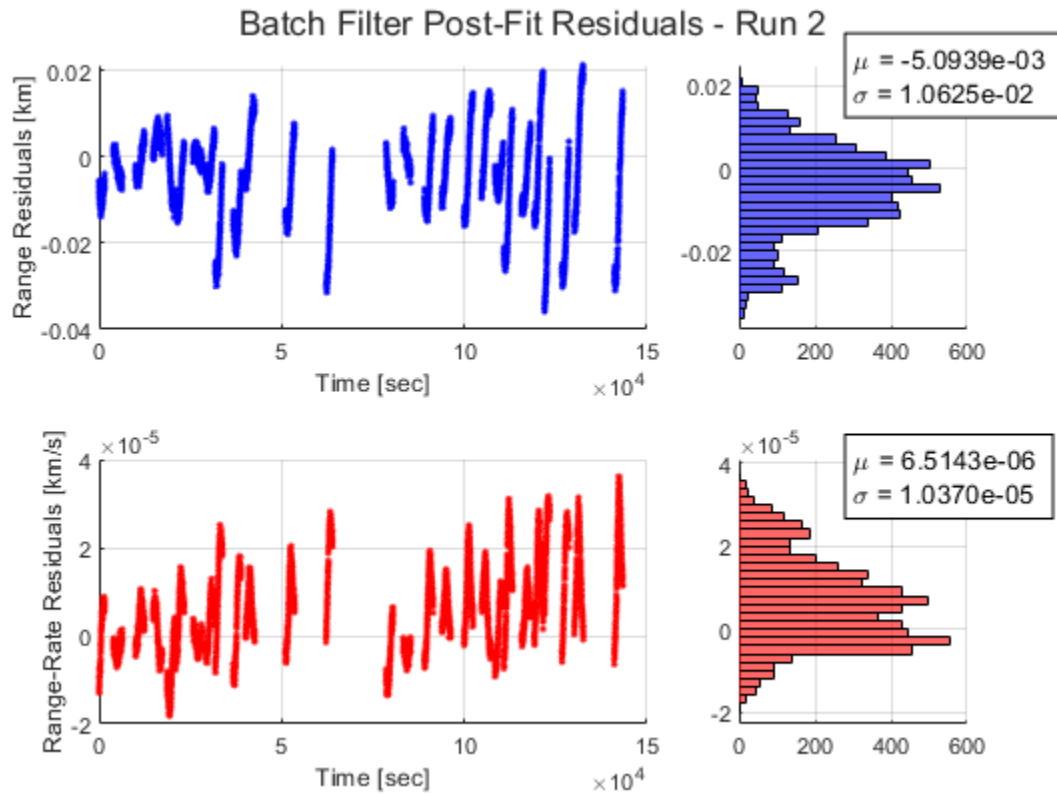
Batch Filter Post-Fit Residuals - Run 1

$\mu = -2.5626\text{e-}01$
$\sigma = 7.8790\text{e+}00$

$\mu = 7.7116\text{e-}03$
$\sigma = 7.3203\text{e-}03$

Batch Filter Post-Fit Residuals - Run 2

$\mu = -5.0939\text{e-}03$
$\sigma = 1.0625\text{e-}02$

$\mu = 6.5143\text{e-}06$
$\sigma = 1.0370\text{e-}05$

Batch Filter Post-Fit Residuals - Run 3

μ = 2.0218e-06
σ = 1.0032e-03

μ = 3.1077e-09
σ = 1.0101e-06

Batch Filter Post-Fit Residuals - Run 4

μ = 2.2327e-06
σ = 1.0032e-03

μ = -5.0741e-09
σ = 1.0100e-06

Batch Filter Estimated State Error ($X_{filt} - X_{ref}$)
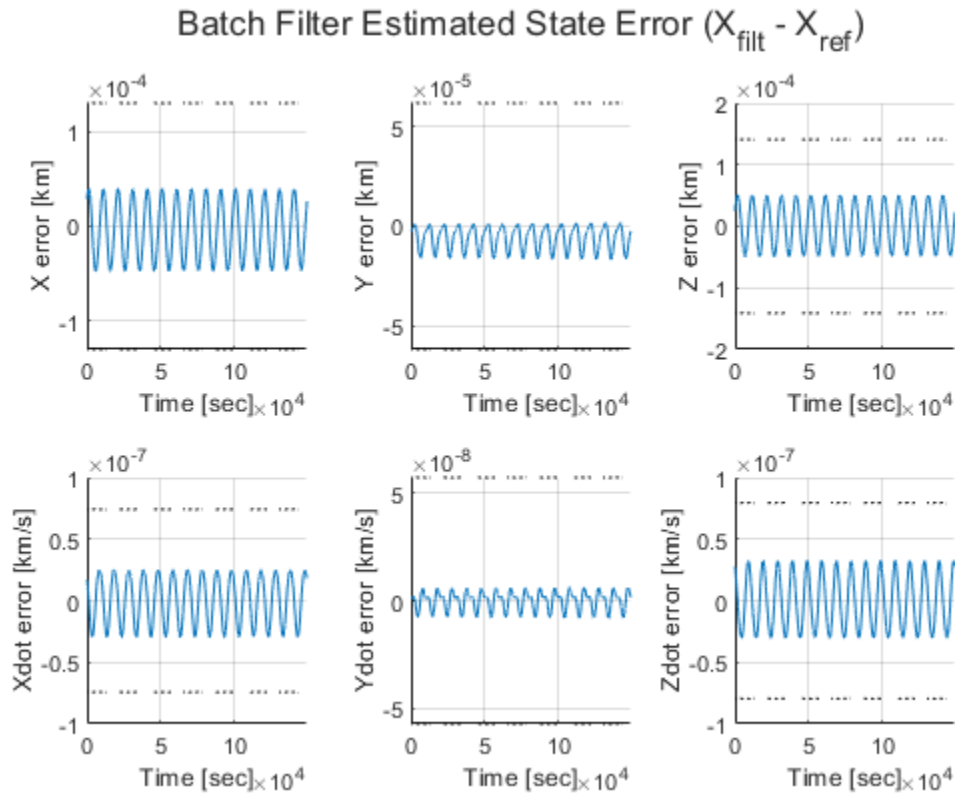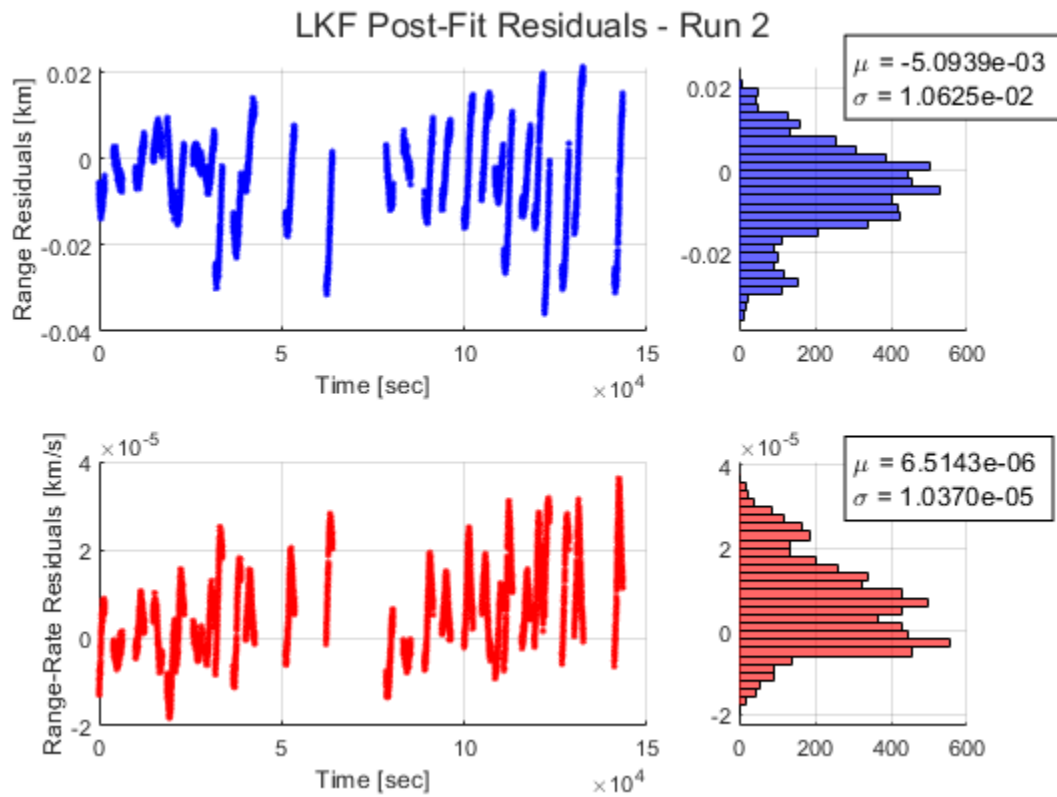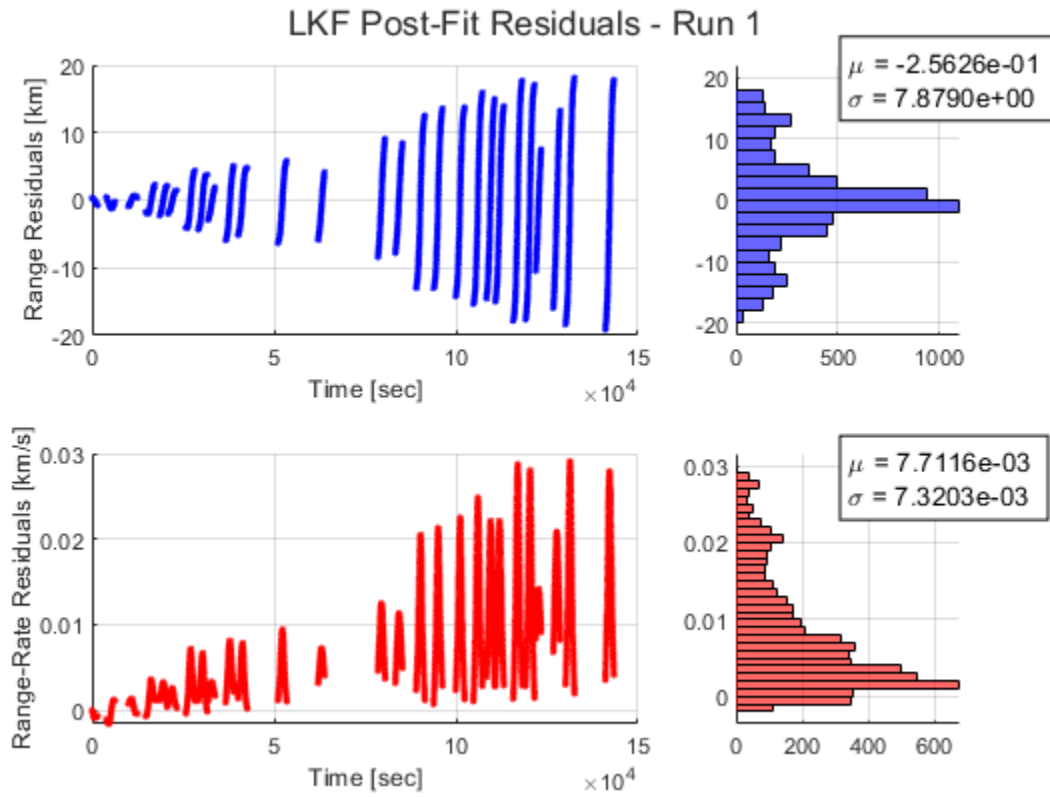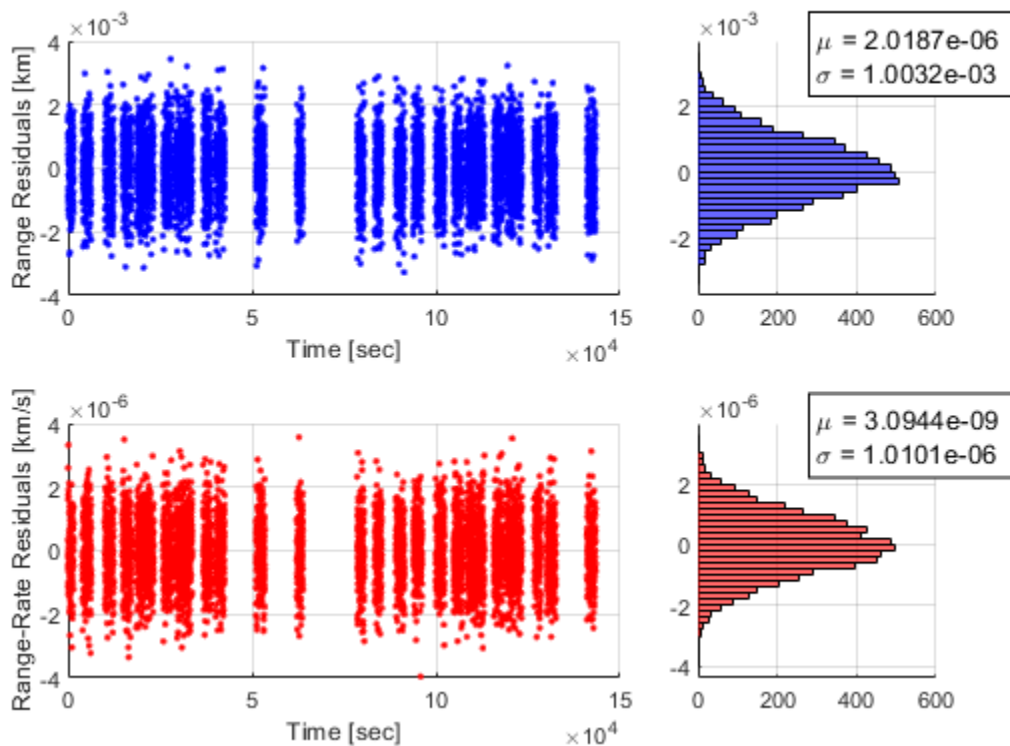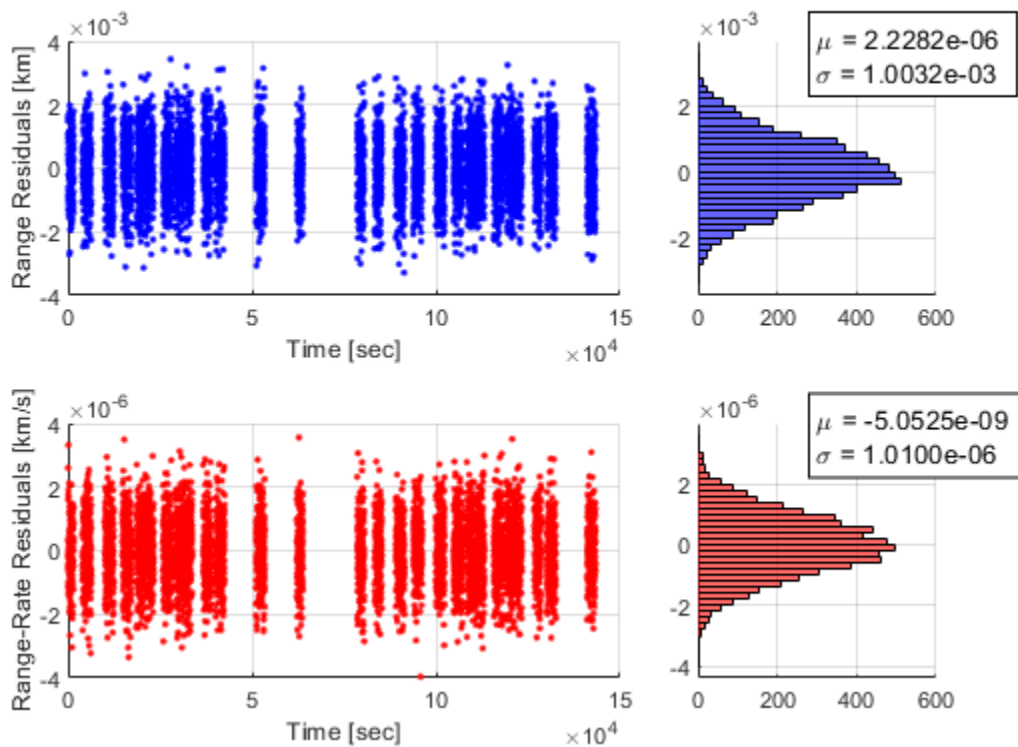
Problem 1b: CKF/LKF

1b. LKF

```
    Running LKF:
Postfit RMS: 25.7373. Iterating LKF with x0_LKF = [4.893e-01; 5.041e-01;
4.898e-01; 4.822e-04; 5.044e-04; 4.762e-04]. Runs so far: 1
Postfit RMS: 1.0029. Iterating LKF with x0_LKF = [1.070e-02; -4.075e-03;
1.023e-02; 1.780e-05; -4.424e-06; 2.385e-05]. Runs so far: 2
Postfit RMS: 1.0029. Iterating LKF with x0_LKF = [3.439e-08; 4.107e-08;
-9.244e-08; 1.191e-10; 2.333e-11; 5.341e-11]. Runs so far: 3
Final postfit RMS: 1.0029. Converged after 4 runs
```
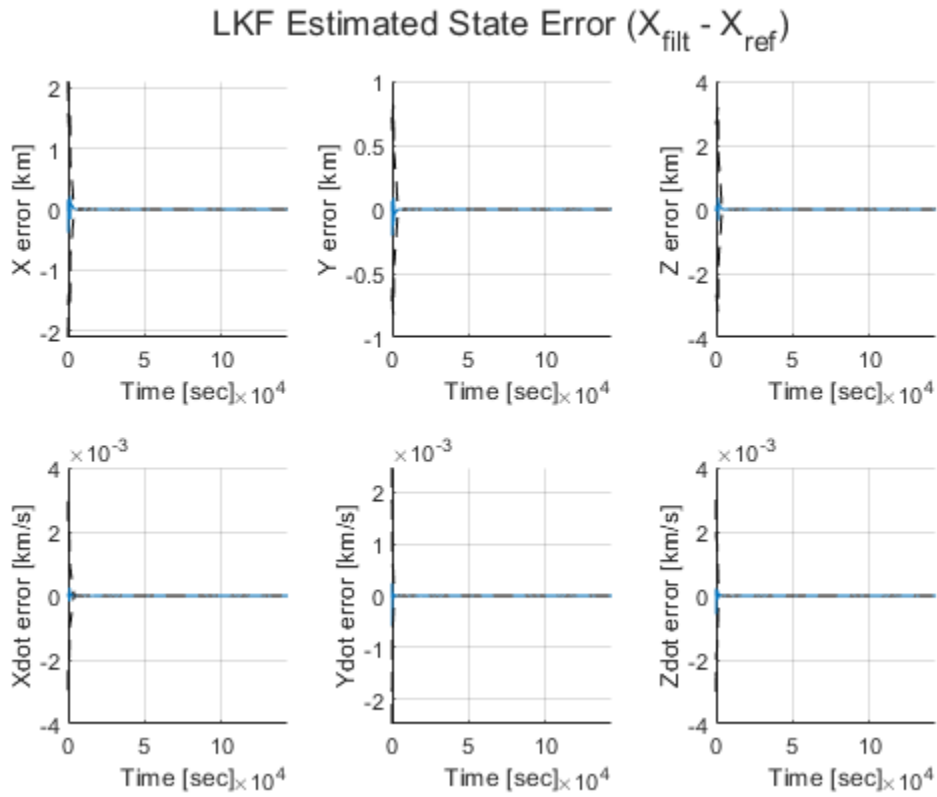
LKF Post-Fit Residuals - Run 1

$\mu = -2.5626e-01$
$\sigma = 7.8790e+00$

$\mu = 7.7116e-03$
$\sigma = 7.3203e-03$

LKF Post-Fit Residuals - Run 2

$\mu = -5.0939e-03$
$\sigma = 1.0625e-02$

$\mu = 6.5143e-06$
$\sigma = 1.0370e-05$

LKF Post-Fit Residuals - Run 3

μ = 2.0187e-06
σ = 1.0032e-03

μ = 3.0944e-09
σ = 1.0101e-06

LKF Post-Fit Residuals - Run 4

μ = 2.2282e-06
σ = 1.0032e-03

μ = -5.0525e-09
σ = 1.0100e-06

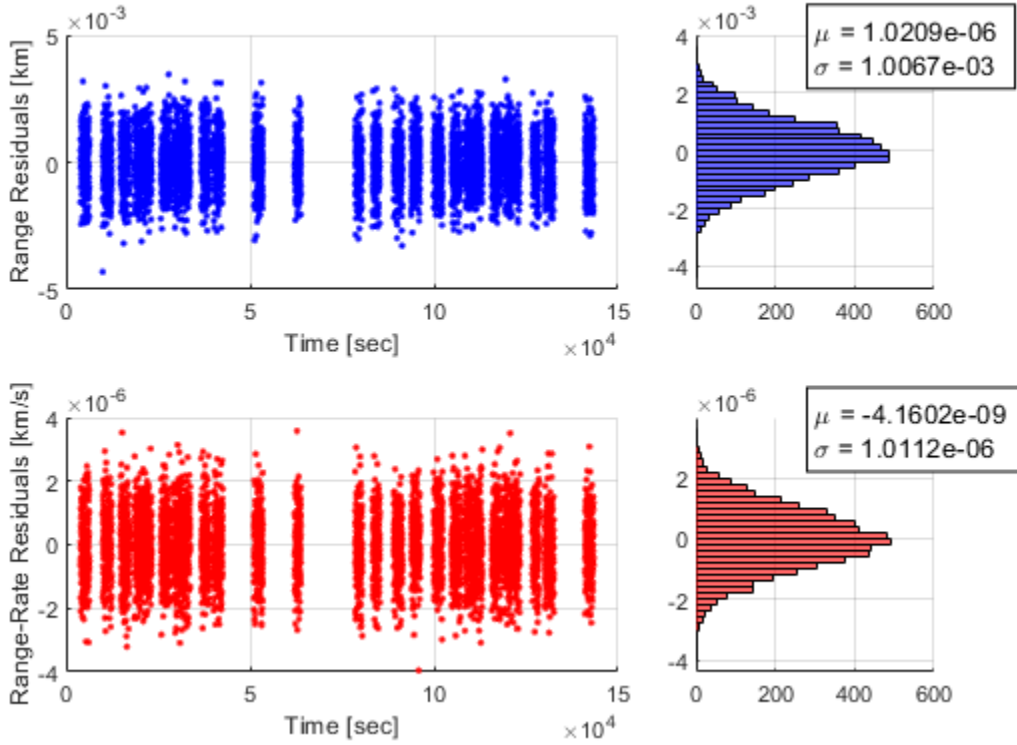## LKF Estimated State Error ($X_{filt} - X_{ref}$)
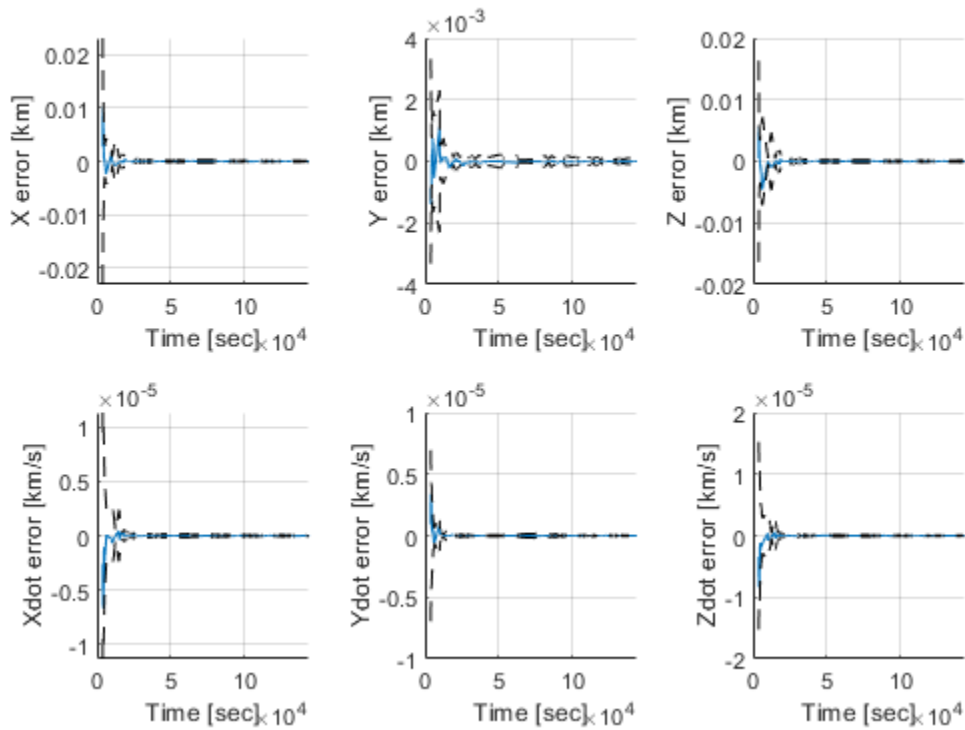

Problem 1b: EKF

1b. EKF

*   Running EKF:*
Postfit RMS: 1.0043

EKF Post-Fit Residuals

EKF Estimated State Error (X_{filt} - X_{ref})

Problem 1d: Increase x0

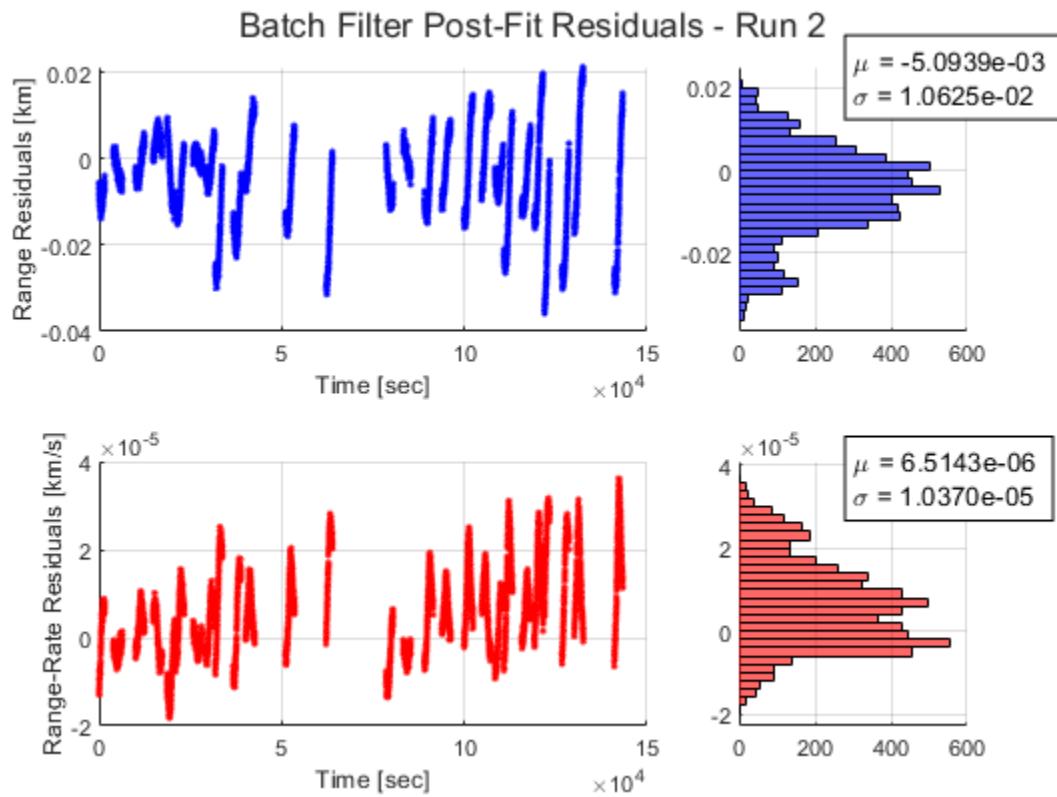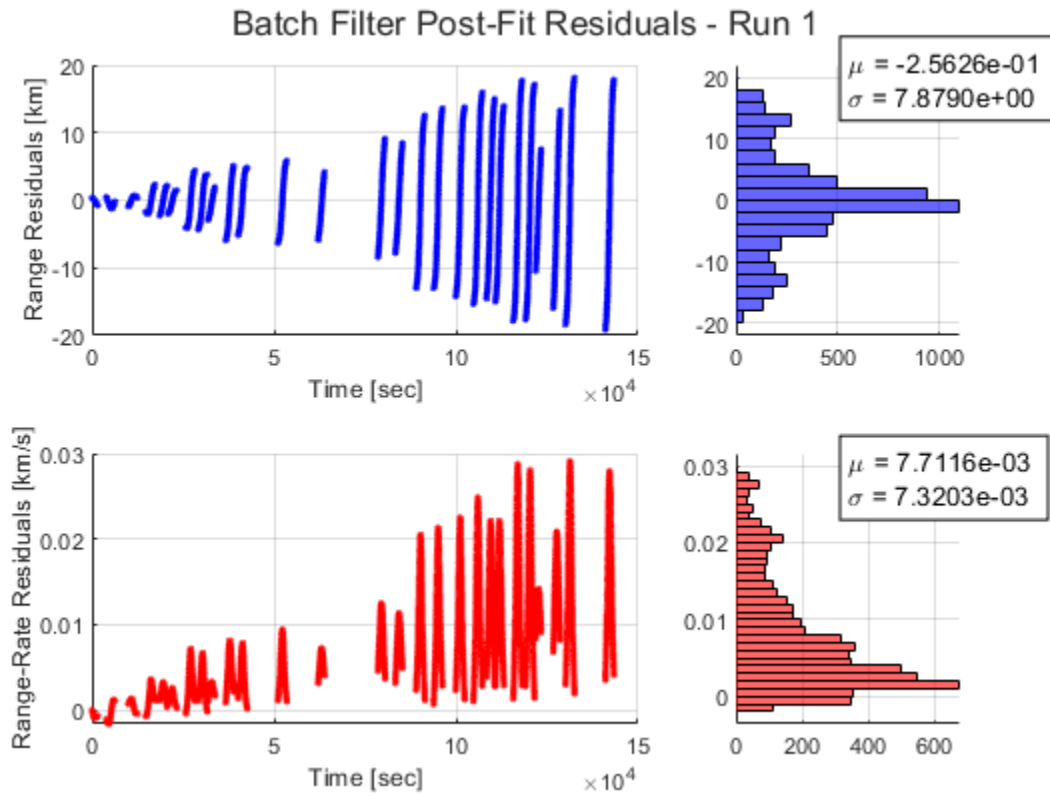*1d. Increased x0*

Running Batch Filter:
Postfit RMS: 25.7449. Iterating Batch with x0_batch = [4.951e+01; 4.950e+01;
4.951e+01; 4.952e-02; 4.950e-02; 4.952e-02]. Runs so far: 1
Postfit RMS: 1.0065. Iterating Batch with x0_batch = [4.950e+01; 4.950e+01;
4.950e+01; 4.950e-02; 4.950e-02; 4.950e-02]. Runs so far: 2
Postfit RMS: 1.0065. Iterating Batch with x0_batch = [4.950e+01; 4.950e+01;
4.950e+01; 4.950e-02; 4.950e-02; 4.950e-02]. Runs so far: 3
Final postfit RMS: 1.0065. Converged after 4 runs


Running LKF:
Postfit RMS: 25.7483. Iterating LKF with x0_LKF = [4.893e-01; 5.041e-01;
4.898e-01; 4.822e-04; 5.044e-04; 4.762e-04]. Runs so far: 1
Postfit RMS: 1.0029. Iterating LKF with x0_LKF = [1.070e-02; -4.075e-03;
1.023e-02; 1.780e-05; -4.424e-06; 2.385e-05]. Runs so far: 2
Postfit RMS: 1.0029. Iterating LKF with x0_LKF = [3.592e-08; 4.190e-08;
-9.354e-08; 1.185e-10; 2.419e-11; 5.383e-11]. Runs so far: 3
Final postfit RMS: 1.0029. Converged after 4 runs
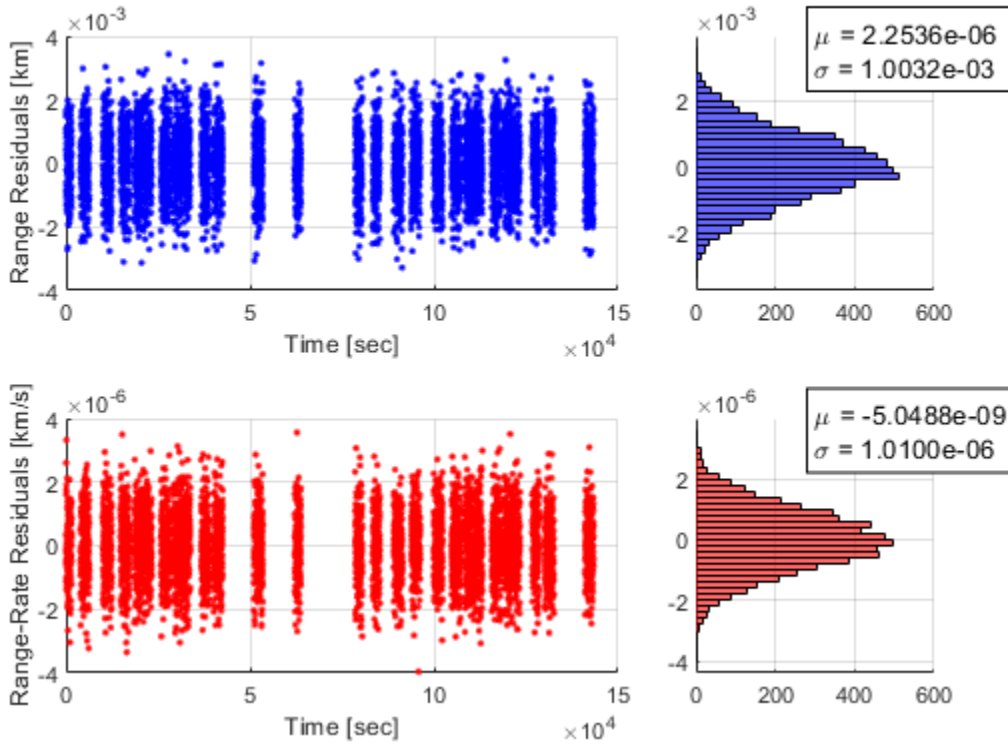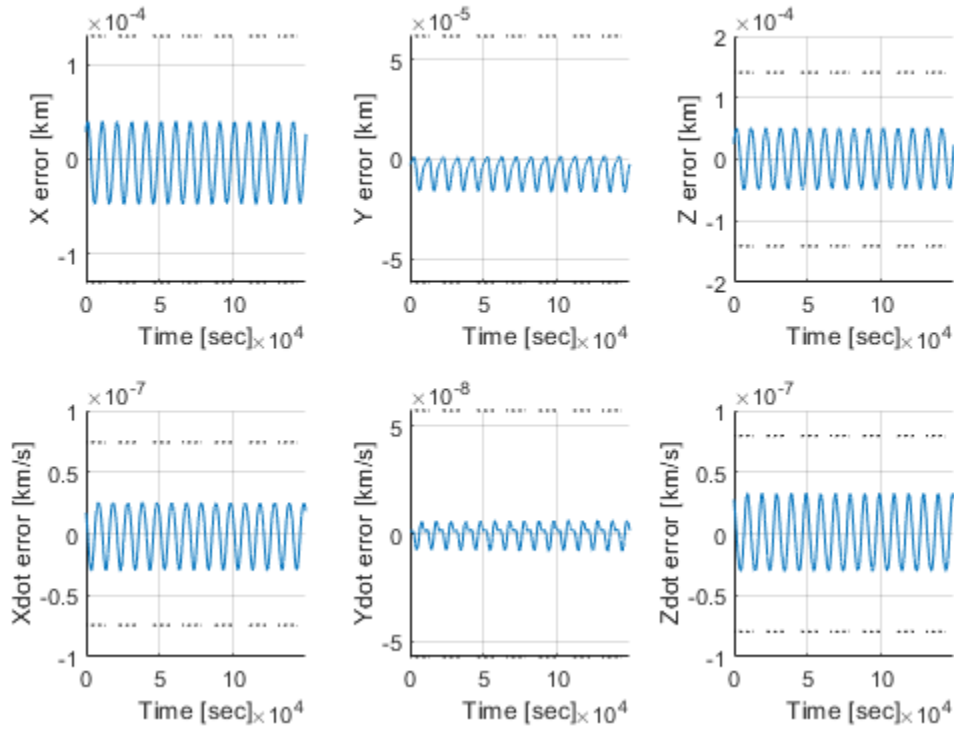

Running EKF:
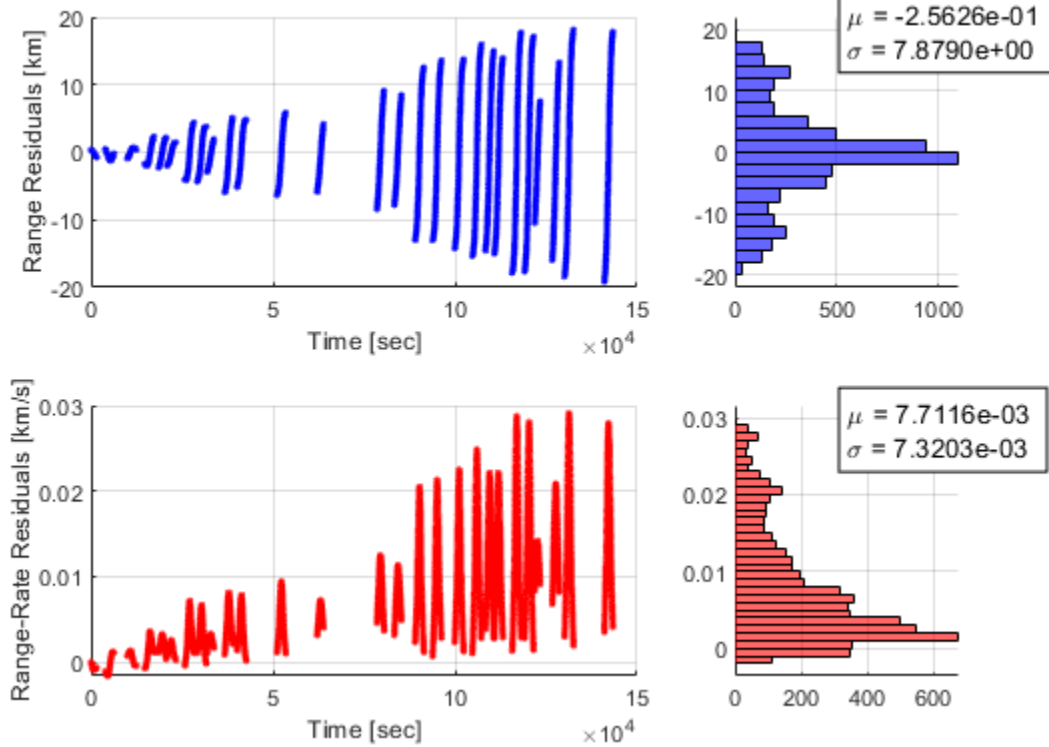*Postfit RMS: 1.0043*

Batch Filter Post-Fit Residuals - Run 1
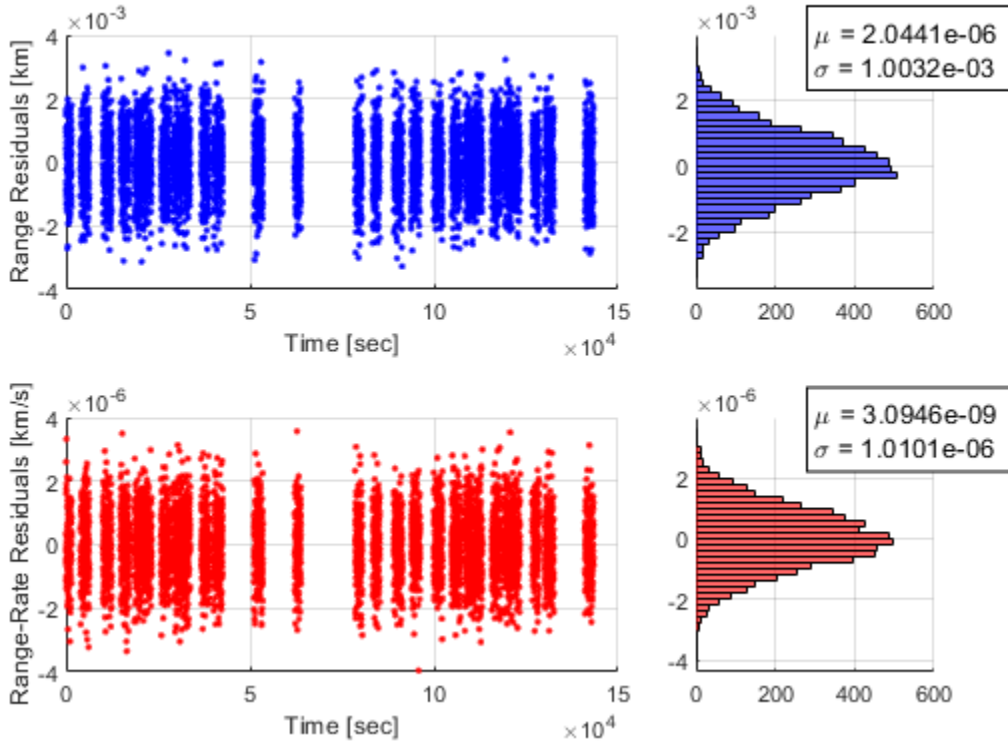
Batch Filter Post-Fit Residuals - Run 2

Batch Filter Post-Fit Residuals - Run 3

$\mu = 2.0441\text{e-}06$
$\sigma = 1.0032\text{e-}03$

$\mu = 3.0946\text{e-}09$
$\sigma = 1.0101\text{e-}06$

Batch Filter Post-Fit Residuals - Run 4

$\mu = 2.2536\text{e-}06$
$\sigma = 1.0032\text{e-}03$

$\mu = -5.0488\text{e-}09$
$\sigma = 1.0100\text{e-}06$

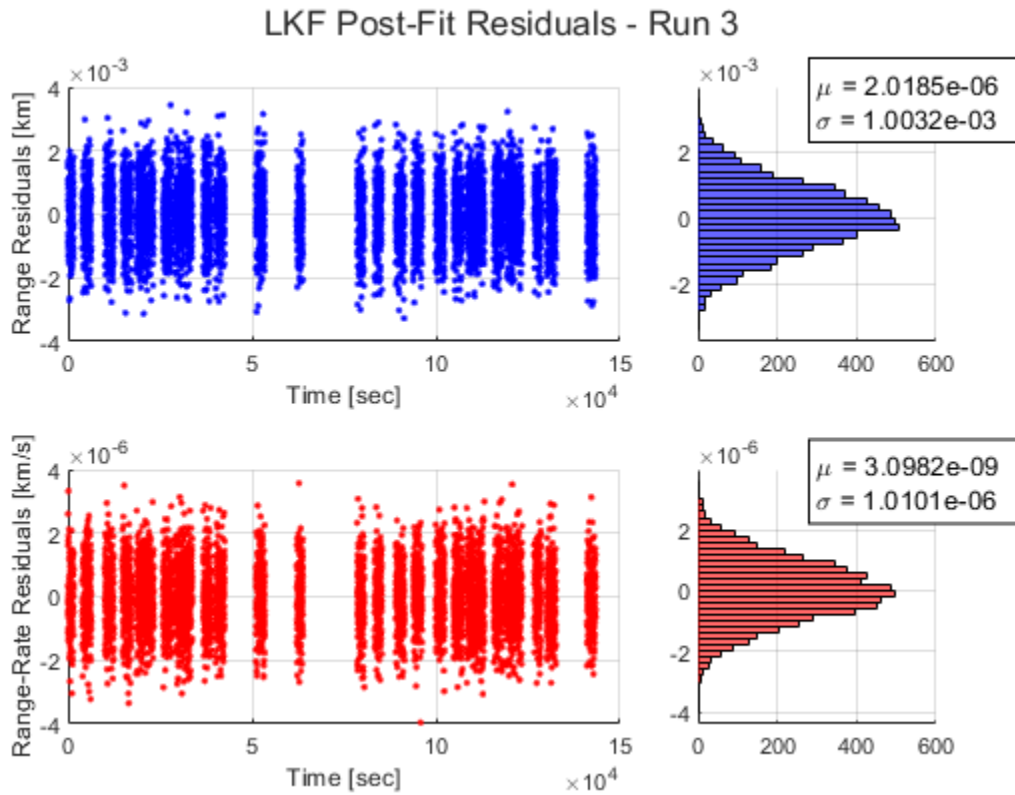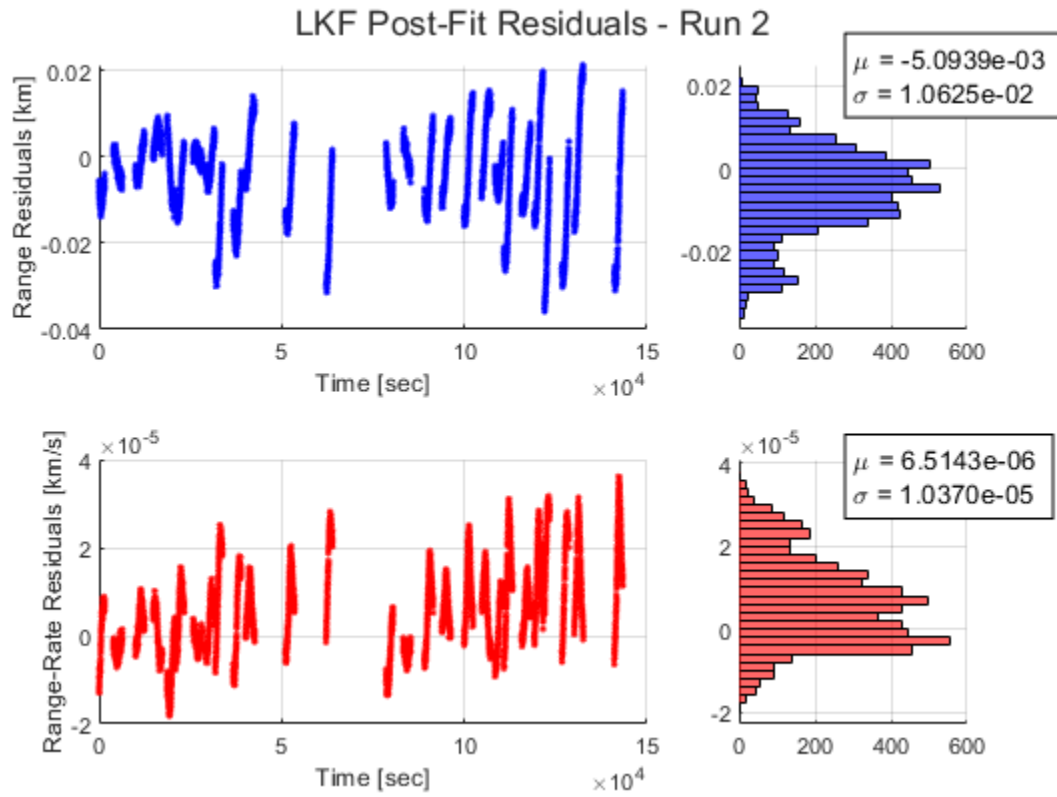## Batch Filter Estimated State Error ($X_{filt} - X_{ref}$)

LKF Post-Fit Residuals - Run 1

$\mu = -2.5626e-01$
$\sigma = 7.8790e+00$

$\mu = 7.7116e-03$
$\sigma = 7.3203e-03$

LKF Post-Fit Residuals - Run 2

$\mu = -5.0939\text{e-}03$
$\sigma = 1.0625\text{e-}02$

$\mu = 6.5143\text{e-}06$
$\sigma = 1.0370\text{e-}05$

LKF Post-Fit Residuals - Run 3

$\mu = 2.0185\text{e-}06$
$\sigma = 1.0032\text{e-}03$

$\mu = 3.0982\text{e-}09$
$\sigma = 1.0101\text{e-}06$

LKF Post-Fit Residuals - Run 4

μ = 2.2283e-06
σ = 1.0032e-03

μ = -5.0577e-09
σ = 1.0100e-06
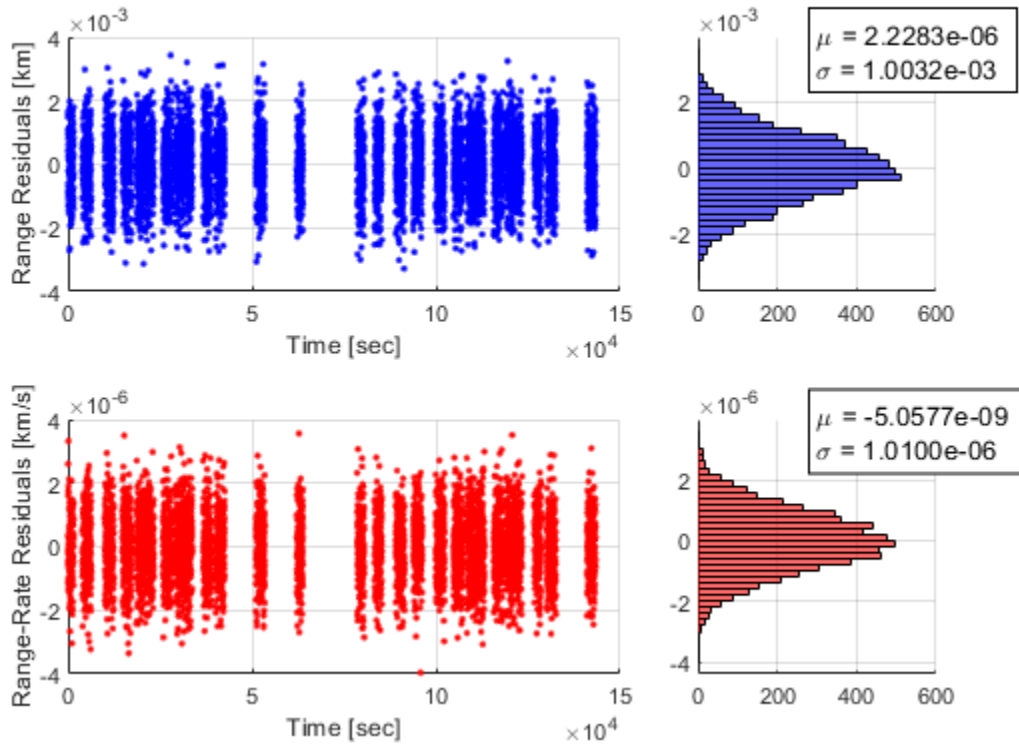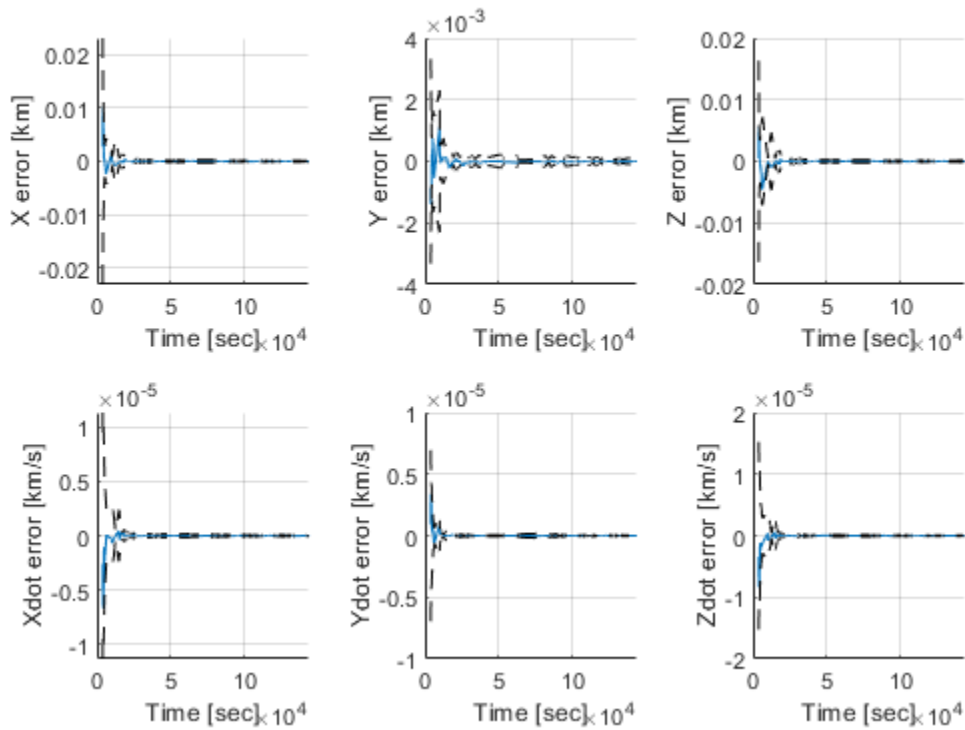
LKF Estimated State Error (X_{filt} - X_{ref})
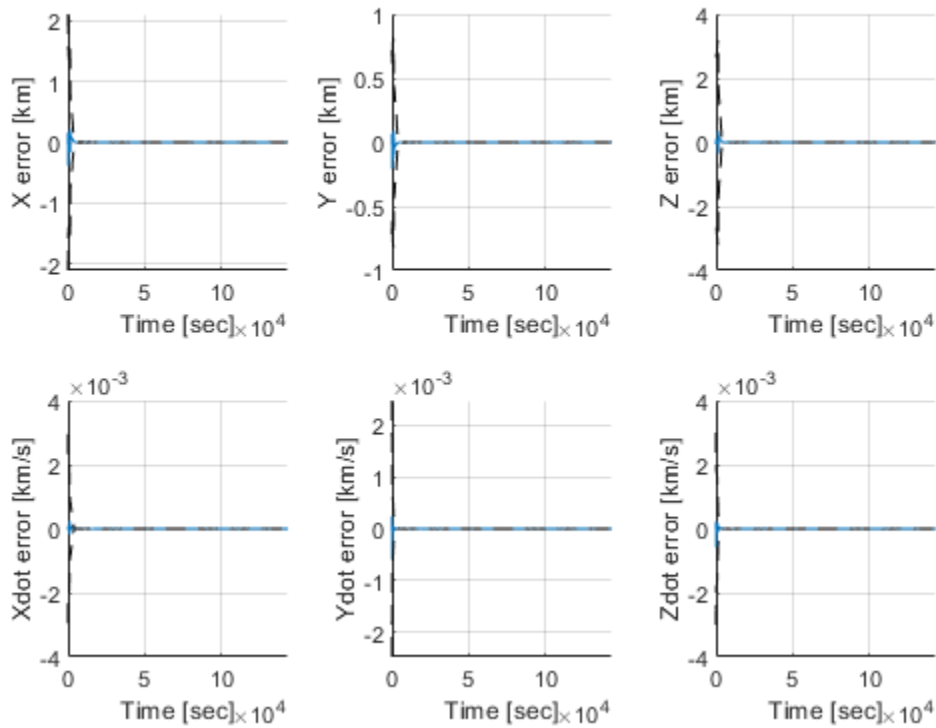
EKF Post-Fit Residuals
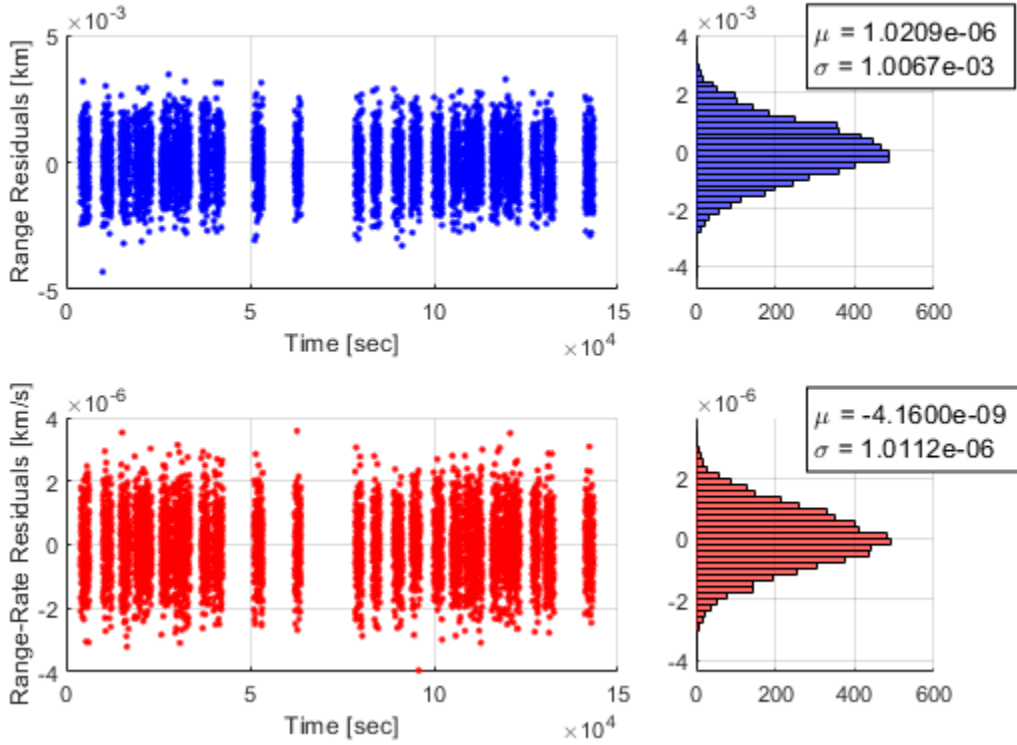
EKF Estimated State Error (X_{filt} - X_{ref})

Problem 1e: Increase P0

1e. Increased P0

*   Running Batch Filter:*
Postfit RMS: 25.7449. Iterating Batch with x0_batch = [4.951e+01; 4.950e+01;
4.951e+01; 4.952e-02; 4.950e-02; 4.952e-02]. Runs so far: 1
Postfit RMS: 1.0065. Iterating Batch with x0_batch = [4.950e+01; 4.950e+01;
4.950e+01; 4.950e-02; 4.950e-02; 4.950e-02]. Runs so far: 2
Postfit RMS: 1.0065. Iterating Batch with x0_batch = [4.950e+01; 4.950e+01;
4.950e+01; 4.950e-02; 4.950e-02; 4.950e-02]. Runs so far: 3
Final postfit RMS: 1.0065. Converged after 4 runs
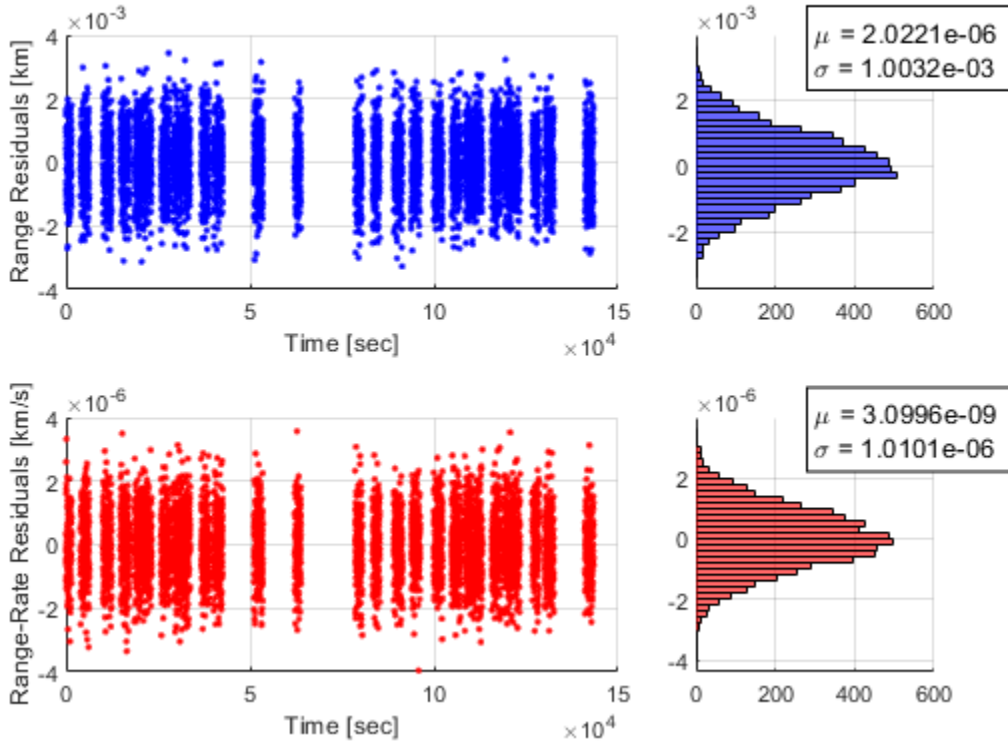
*   Running LKF:*
Postfit RMS: 25.7500. Iterating LKF with x0_LKF = [4.884e-01; 5.039e-01;
4.895e-01; 4.822e-04; 5.042e-04; 4.759e-04]. Runs so far: 1
Postfit RMS: 8.8852. Iterating LKF with x0_LKF = [1.143e-02; -3.944e-03;
1.047e-02; 1.781e-05; -4.248e-06; 2.412e-05]. Runs so far: 2
Postfit RMS: 24.2410. Iterating LKF with x0_LKF = [1.288e-04; 7.696e-05;
-3.431e-05; -1.585e-08; 7.017e-08; 4.587e-08]. Runs so far: 3
Postfit RMS: 5.9785. Iterating LKF with x0_LKF = [-7.009e-05; -9.834e-05;
1.114e-04; 3.027e-08; -7.961e-08; -2.710e-08]. Runs so far: 4
Final postfit RMS: 392.4142. Hit maximum number of 5 runs
Warning: Imaginary parts of complex X and/or Y arguments ignored.
Warning: Imaginary parts of complex X and/or Y arguments ignored.
Warning: Imaginary parts of complex X and/or Y arguments ignored.
Warning: Imaginary parts of complex X and/or Y arguments ignored.
Warning: Imaginary parts of complex X and/or Y arguments ignored.
Warning: Imaginary parts of complex X and/or Y arguments ignored.
Warning: Imaginary parts of complex X and/or Y arguments ignored.
Warning: Imaginary parts of complex X and/or Y arguments ignored.
Warning: Imaginary parts of complex X and/or Y arguments ignored.
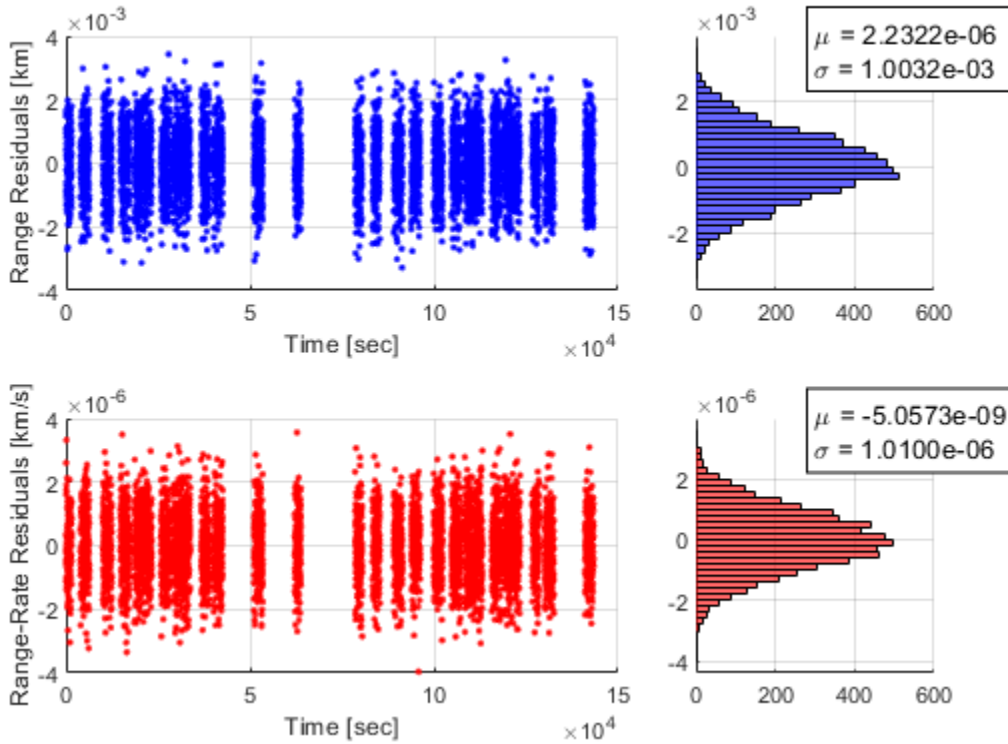*Warning: Imaginary parts of complex X and/or Y arguments ignored.*
Warning: Imaginary parts of complex X and/or Y arguments ignored.
Warning: Imaginary parts of complex X and/or Y arguments ignored.

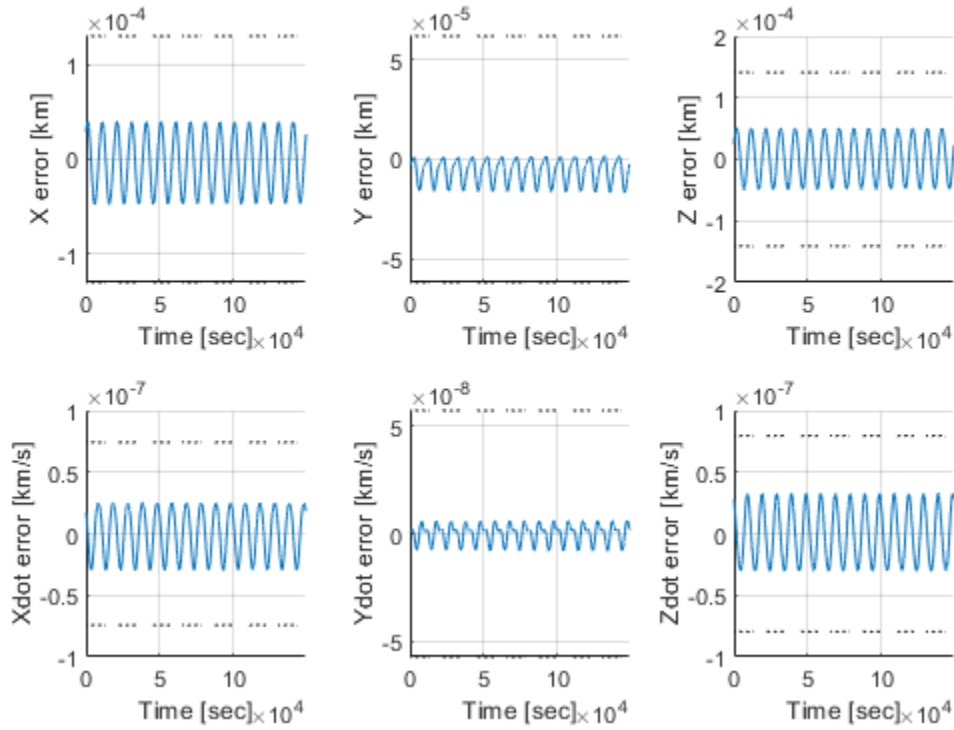*   Running EKF:*
Postfit RMS: 1.0282
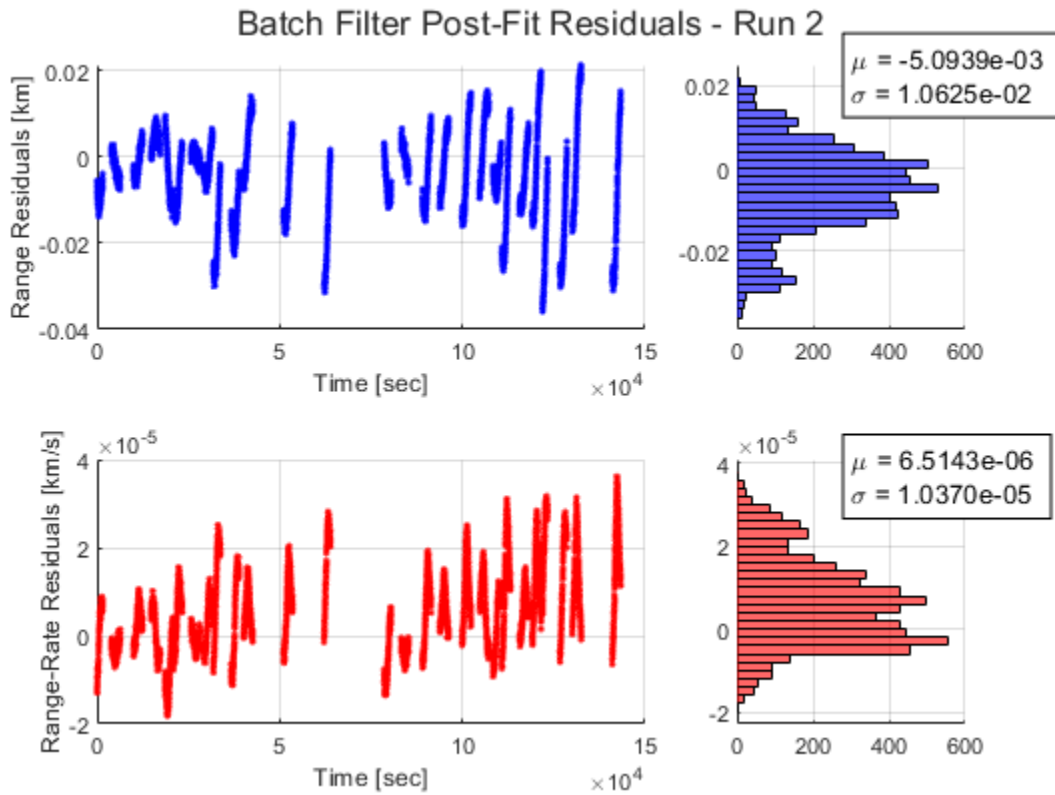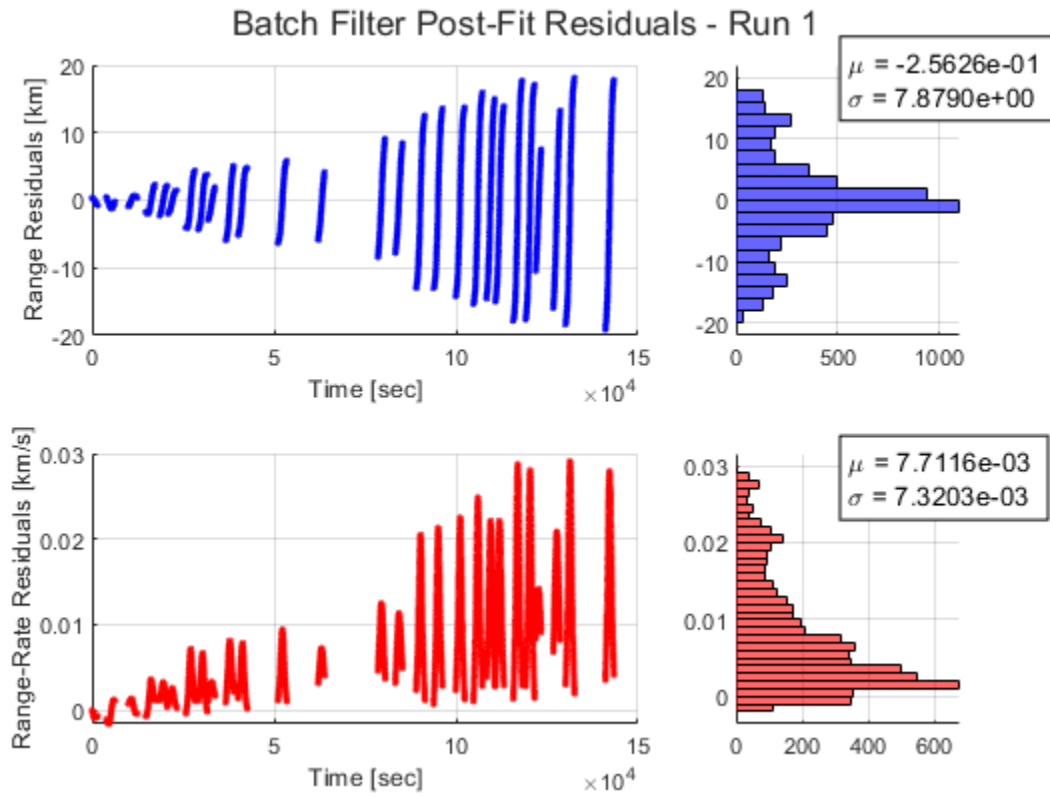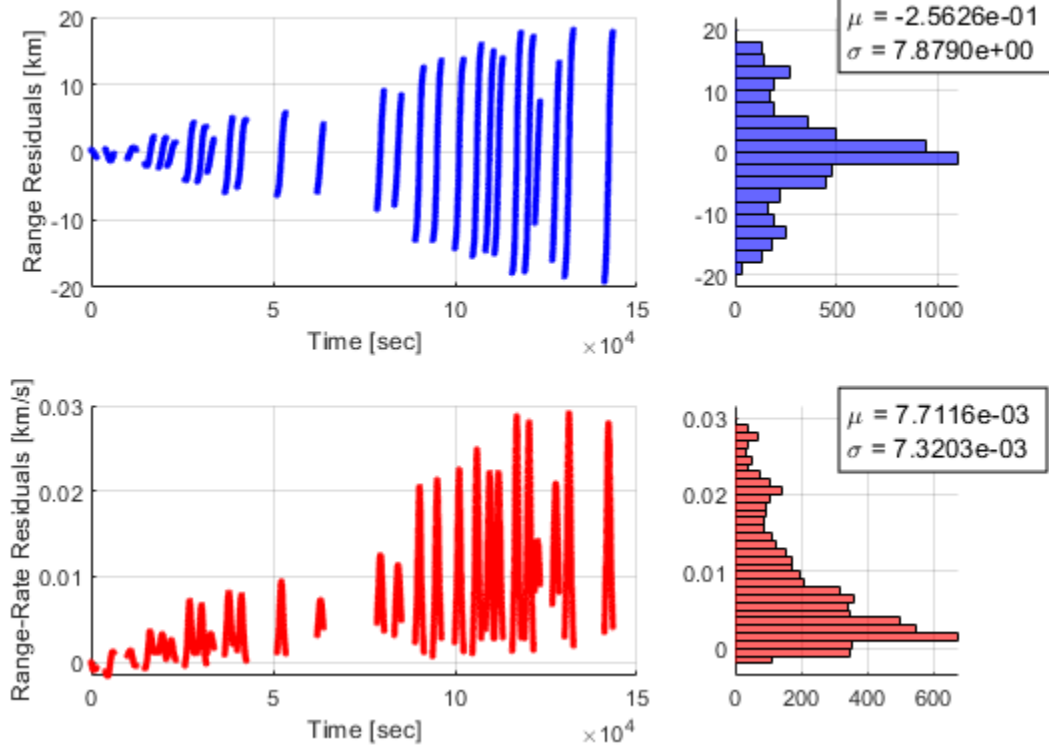
Batch Filter Post-Fit Residuals - Run 1

$\mu = -2.5626\text{e-}01$
$\sigma = 7.8790\text{e+}00$

$\mu = 7.7116\text{e-}03$
$\sigma = 7.3203\text{e-}03$

Batch Filter Post-Fit Residuals - Run 2

$\mu = -5.0939\text{e-}03$
$\sigma = 1.0625\text{e-}02$

$\mu = 6.5143\text{e-}06$
$\sigma = 1.0370\text{e-}05$

Batch Filter Post-Fit Residuals - Run 3

$\mu = 2.0221\text{e-}06$
$\sigma = 1.0032\text{e-}03$

$\mu = 3.0996\text{e-}09$
$\sigma = 1.0101\text{e-}06$

Batch Filter Post-Fit Residuals - Run 4

$\mu = 2.2322\text{e-}06$
$\sigma = 1.0032\text{e-}03$

$\mu = -5.0573\text{e-}09$
$\sigma = 1.0100\text{e-}06$

Batch Filter Estimated State Error ($X_{filt} - X_{ref}$)

LKF Post-Fit Residuals - Run 1

$\mu = -2.5626e{-}01$
$\sigma = 7.8790e{+}00$

$\mu = 7.7116e{-}03$
$\sigma = 7.3203e{-}03$

LKF Post-Fit Residuals - Run 2
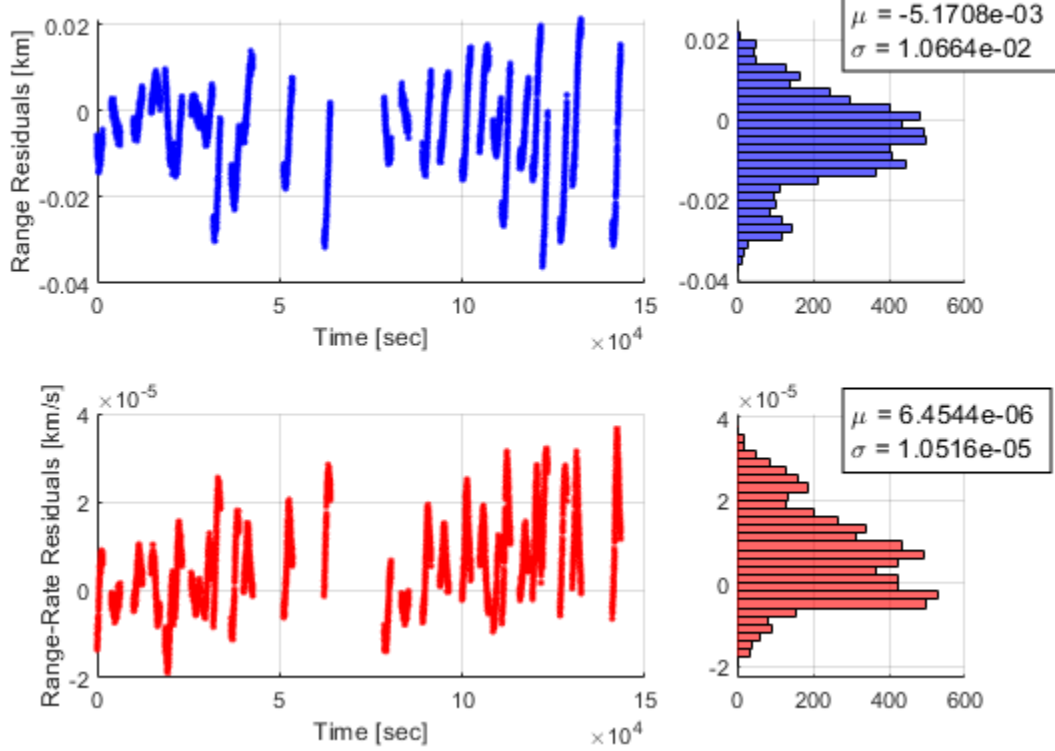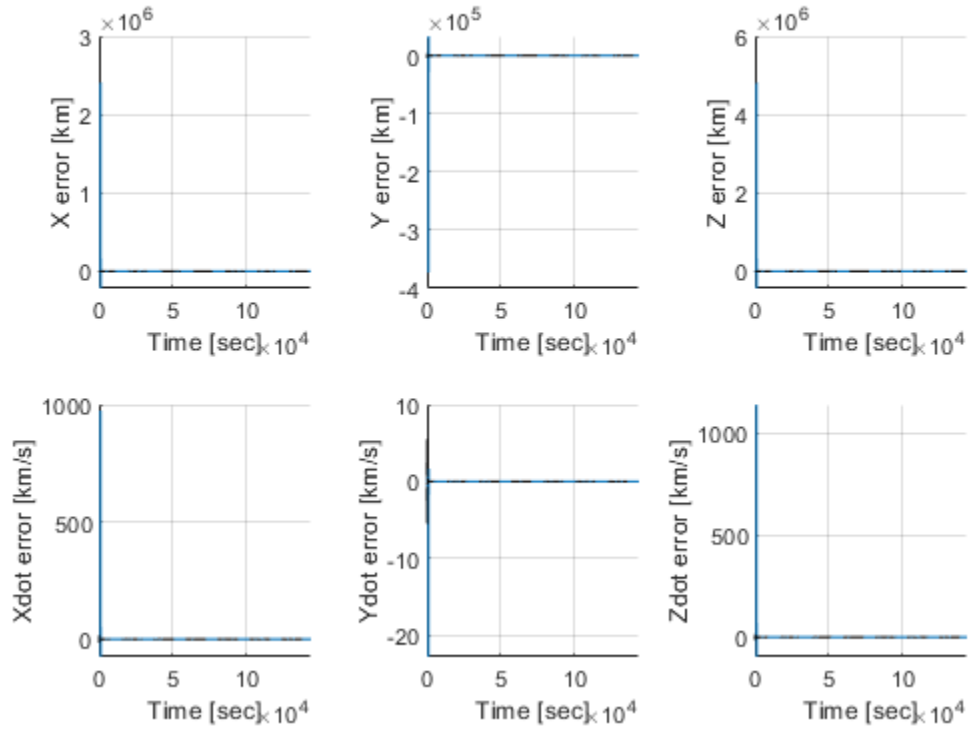

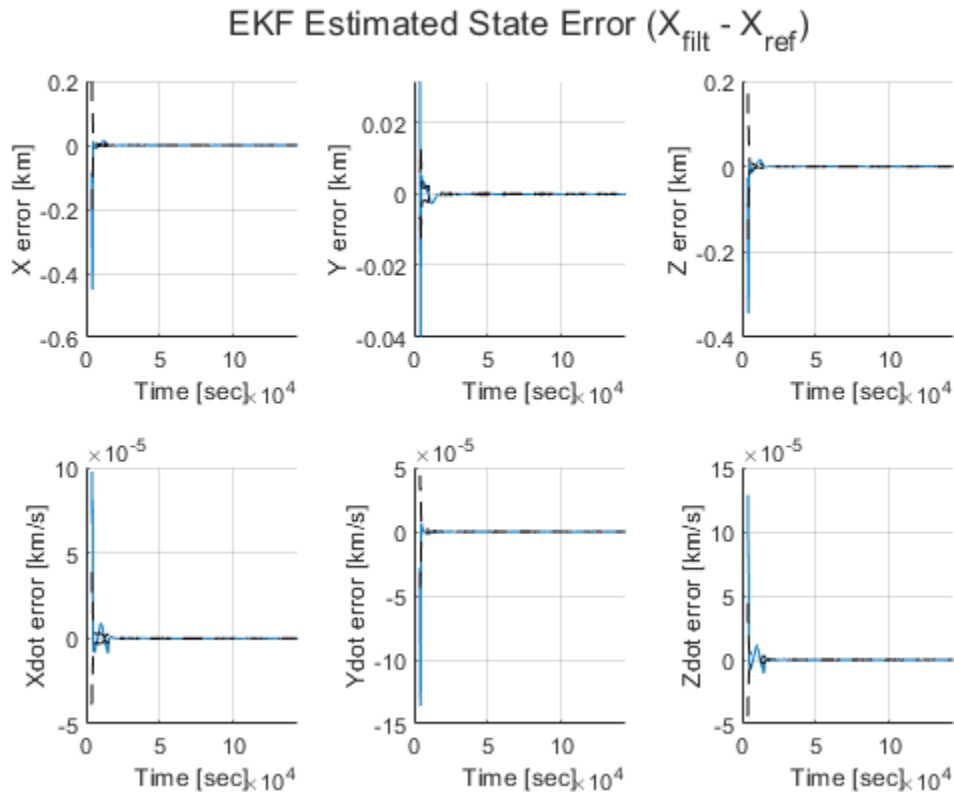LKF Post-Fit Residuals - Run 3
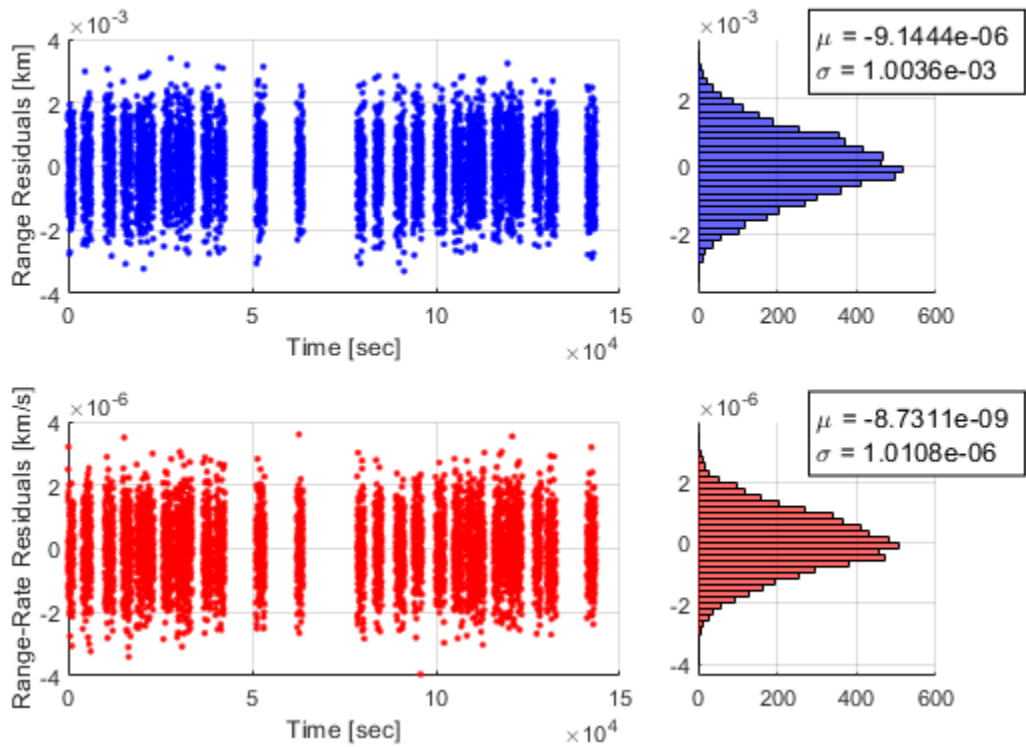
LKF Post-Fit Residuals - Run 4
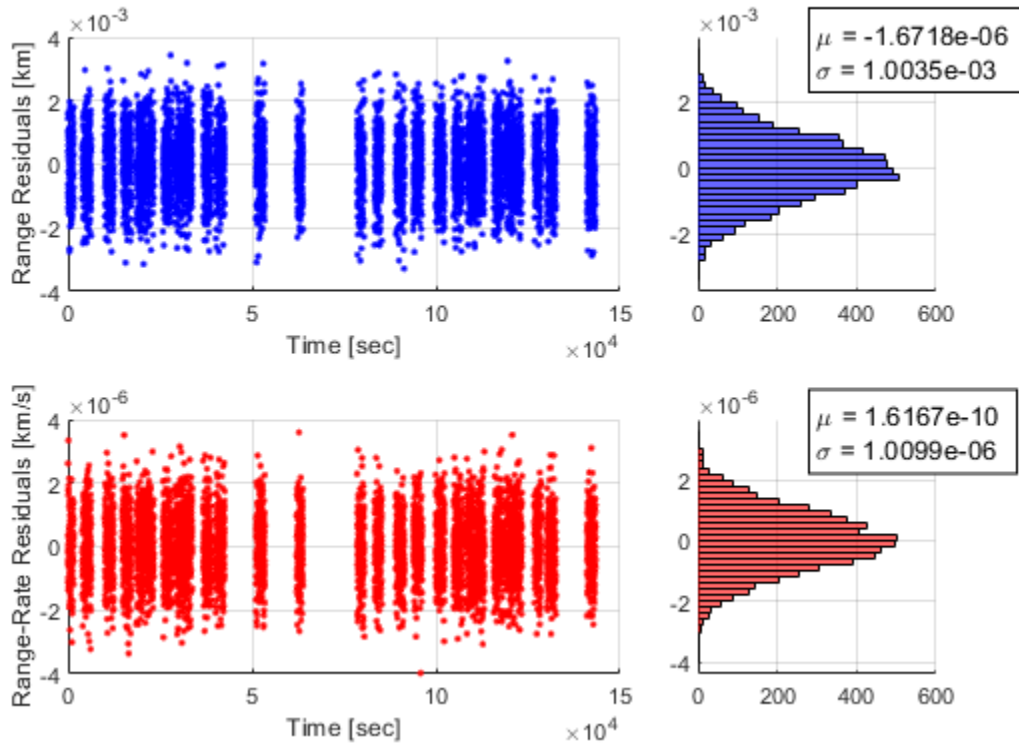
LKF Post-Fit Residuals - Run 5

LKF Estimated State Error (X_{filt} - X_{ref})

EKF Post-Fit Residuals

μ = 3.5421e-05
σ = 1.0148e-03

μ = -3.9418e-09
σ = 1.0554e-06
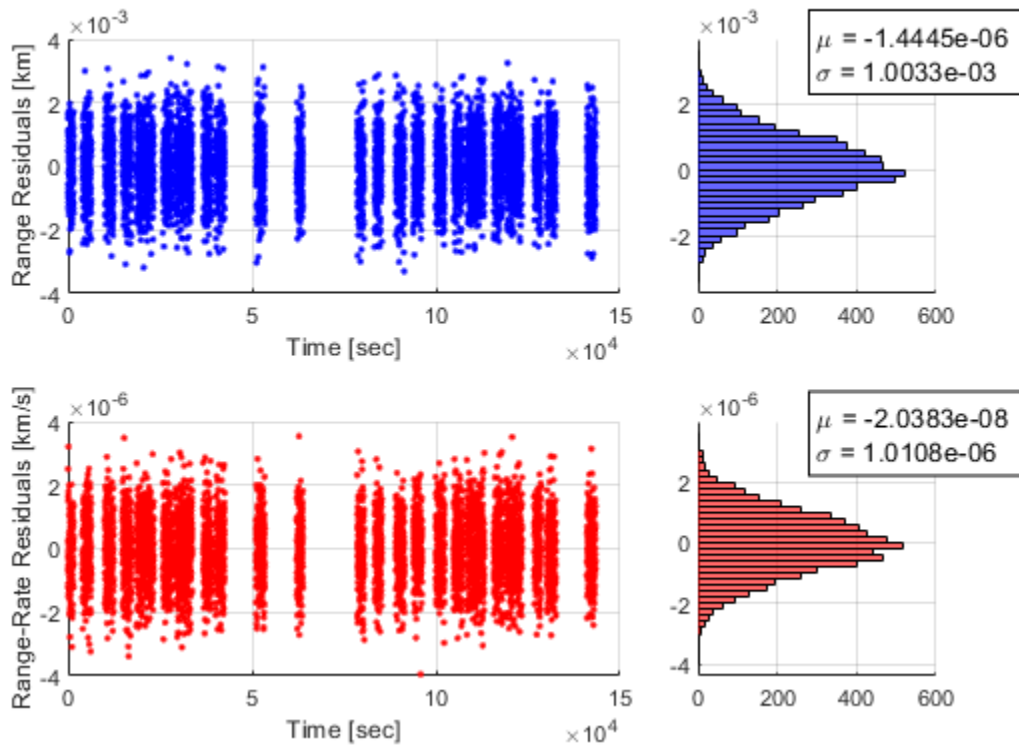
EKF Estimated State Error (X_{filt} - X_{ref})
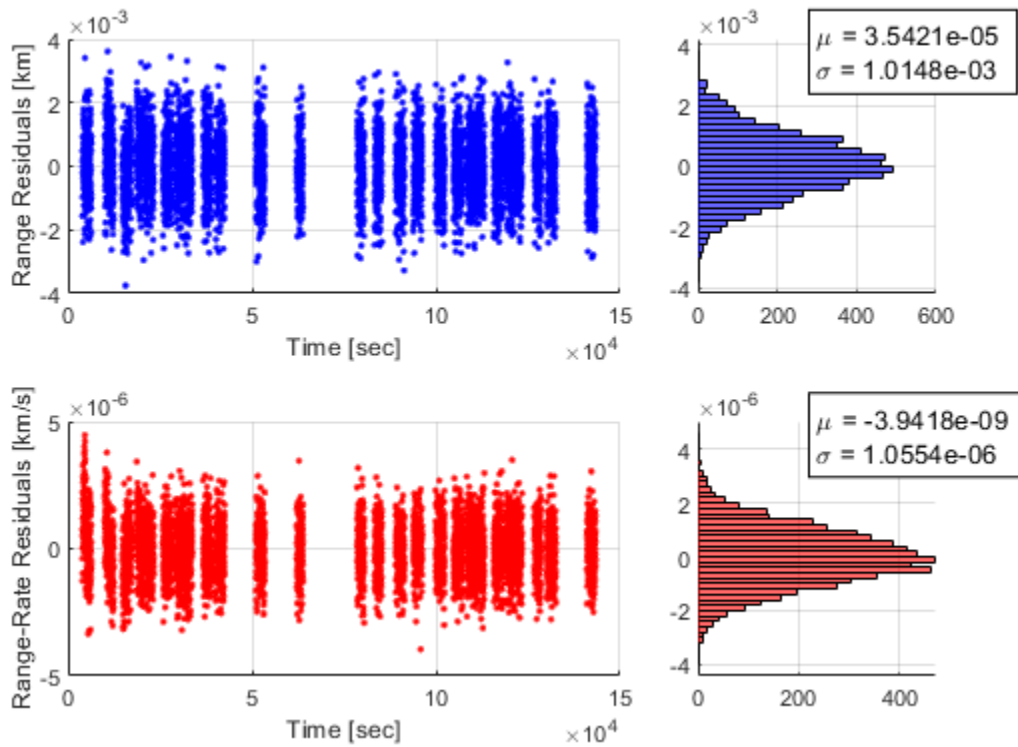
Problem 1f: Process half the measurements

Warning: Integer operands are required for colon operator when used as
index.
Warning: Integer operands are required for colon operator when used as
index.
Warning: Integer operands are required for colon operator when used as
index.
Warning: Integer operands are required for colon operator when used as
index.
Warning: Integer operands are required for colon operator when used as
index.

1f. Half measurements

    Running Batch Filter:
Postfit RMS: 4.1014. Iterating Batch with x0_batch = [5.332e-03; -2.111e-03;
7.824e-03; 3.520e-06; -1.241e-06; 4.037e-06]. Runs so far: 1
Postfit RMS: 1.0172. Iterating Batch with x0_batch = [-6.308e-05;
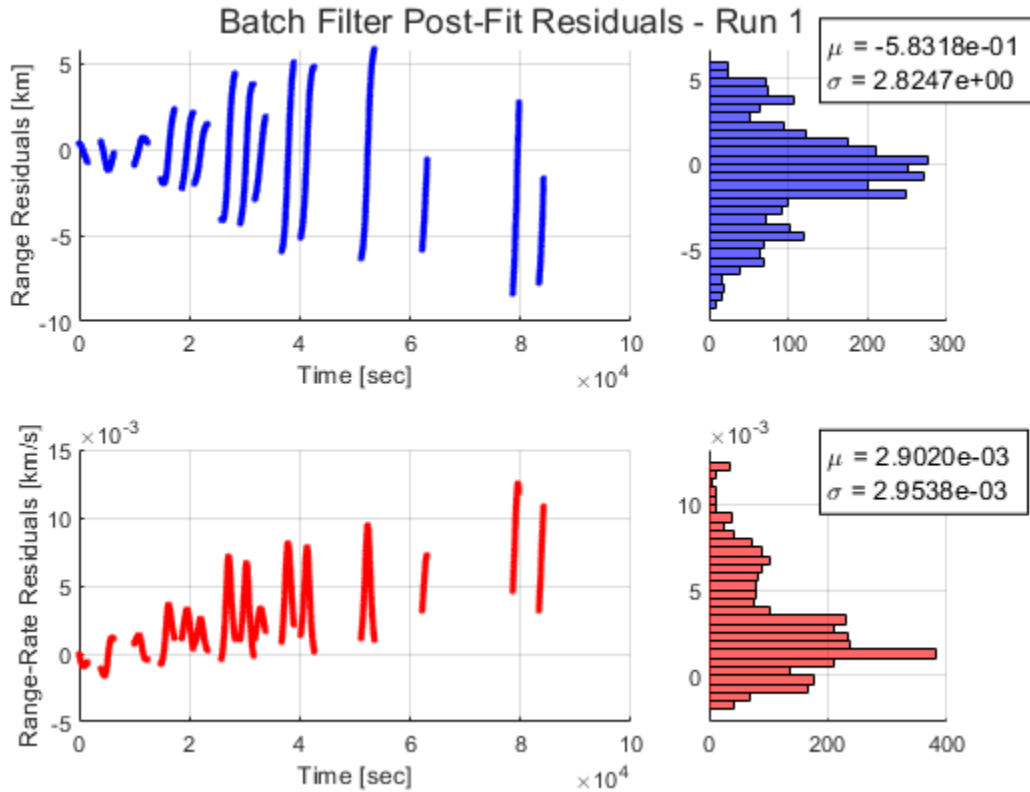*-2.934e-06; -2.034e-05; -3.293e-09; -1.624e-08; -3.591e-08]. Runs so far: 2*
Final postfit RMS: 1.0172. Converged after 3 runs
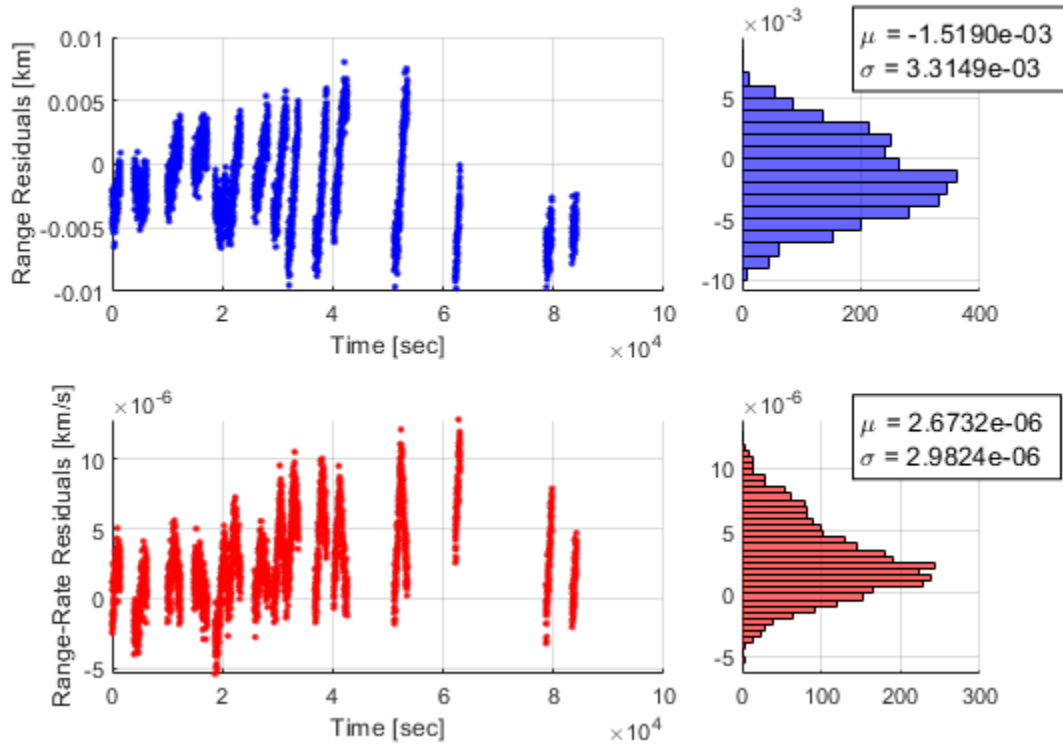
    Running LKF:
Postfit RMS: 4.0959. Iterating LKF with x0_LKF = [4.947e-01; 5.021e-01;

4.922e-01; 4.965e-04; 5.012e-04; 4.960e-04]. Runs so far: 1
Postfit RMS: 1.0105. Iterating LKF with x0_LKF = [5.395e-03; -2.108e-03;
7.845e-03; 3.523e-06; -1.225e-06; 4.073e-06]. Runs so far: 2
Postfit RMS: 1.0105. Iterating LKF with x0_LKF = [5.323e-09; -1.762e-09;
-6.386e-09; 7.267e-12; -2.229e-12; 4.500e-12]. Runs so far: 3
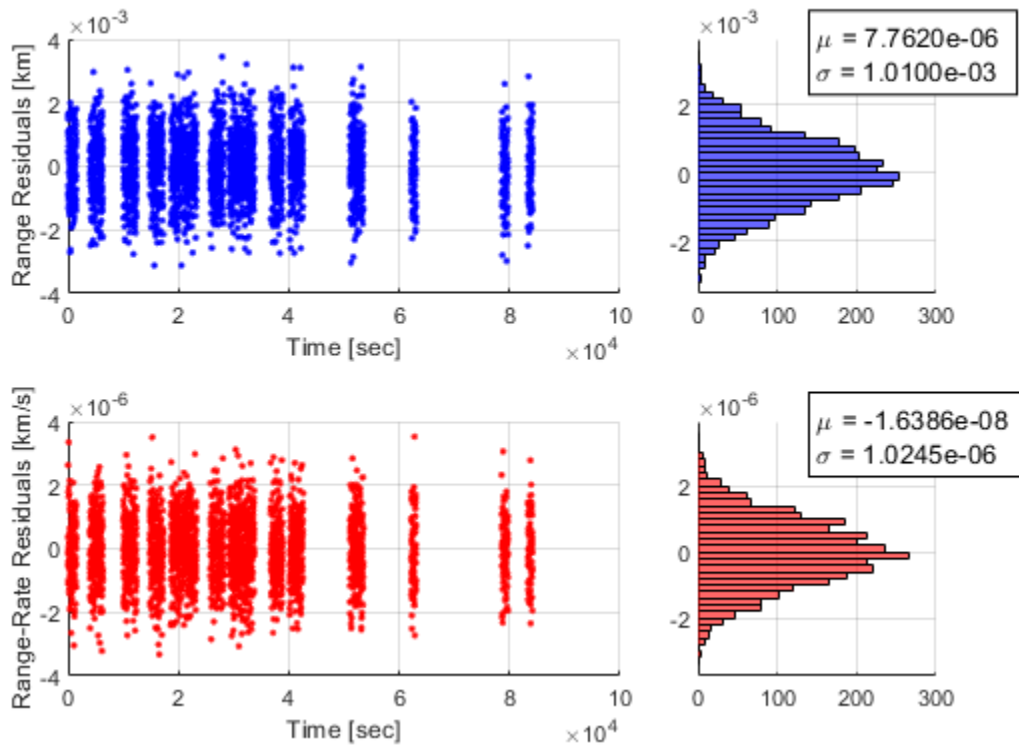*Final postfit RMS: 1.0105. Converged after 4 runs*
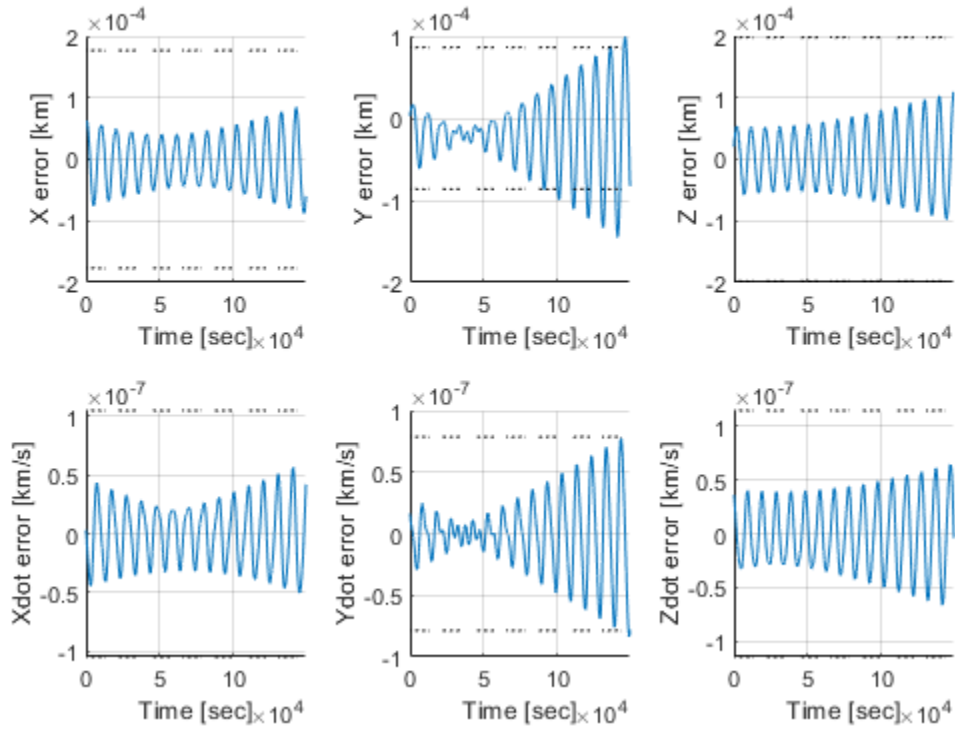
Running EKF:
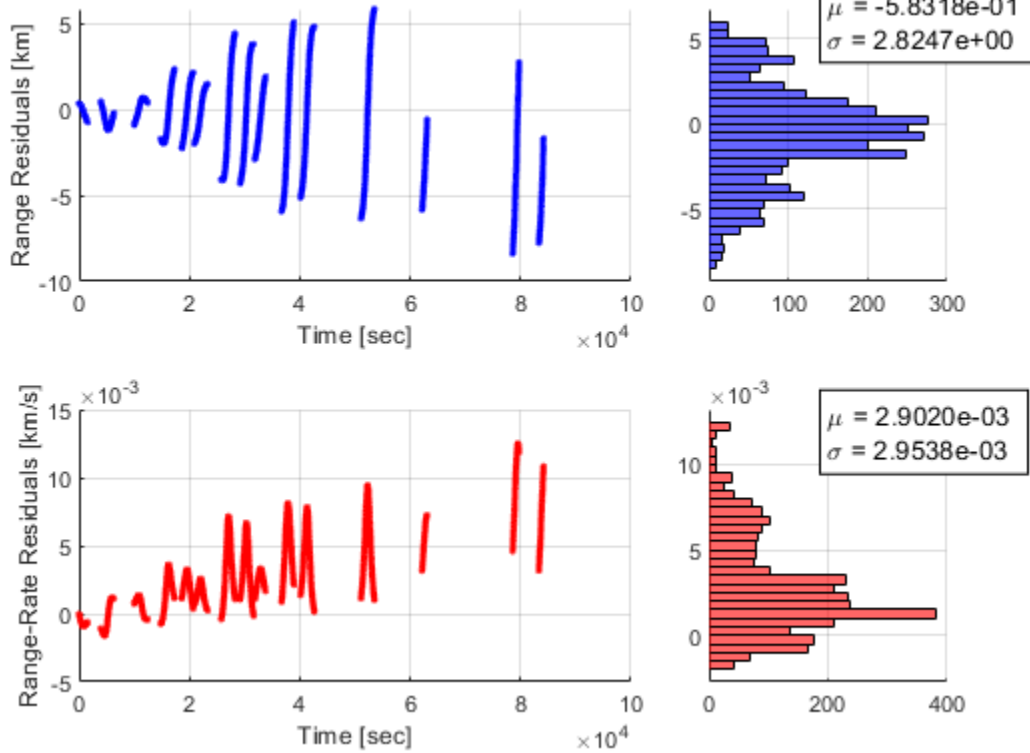*Postfit RMS: 1.0137*

Batch Filter Post-Fit Residuals - Run 2

μ = -1.5190e-03
σ = 3.3149e-03

μ = 2.6732e-06
σ = 2.9824e-06

Batch Filter Post-Fit Residuals - Run 3

μ = 7.7620e-06
σ = 1.0100e-03

μ = -1.6386e-08
σ = 1.0245e-06

Batch Filter Estimated State Error (X_{filt} - X_{ref})

LKF Post-Fit Residuals - Run 1

μ = -5.8318e-01
σ = 2.8247e+00

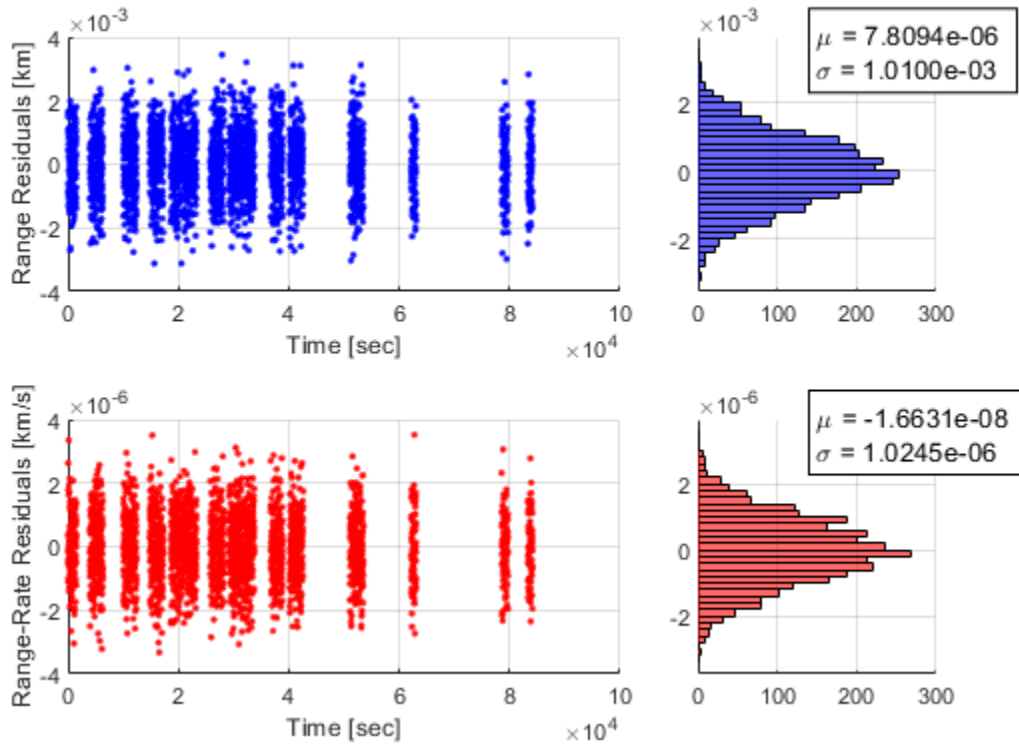μ = 2.9020e-03
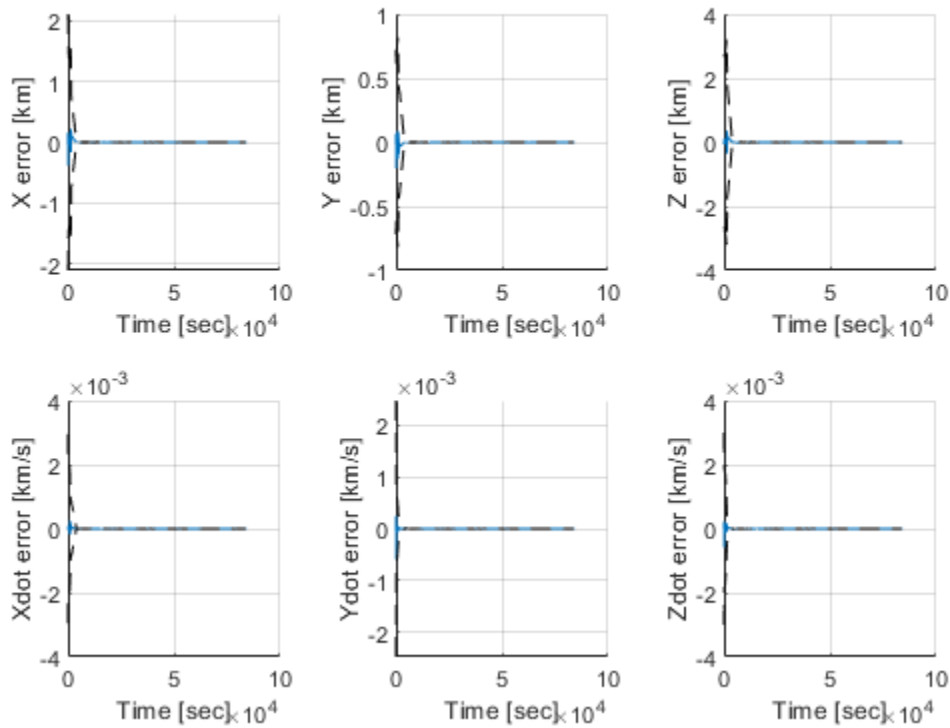σ = 2.9538e-03

LKF Post-Fit Residuals - Run 2
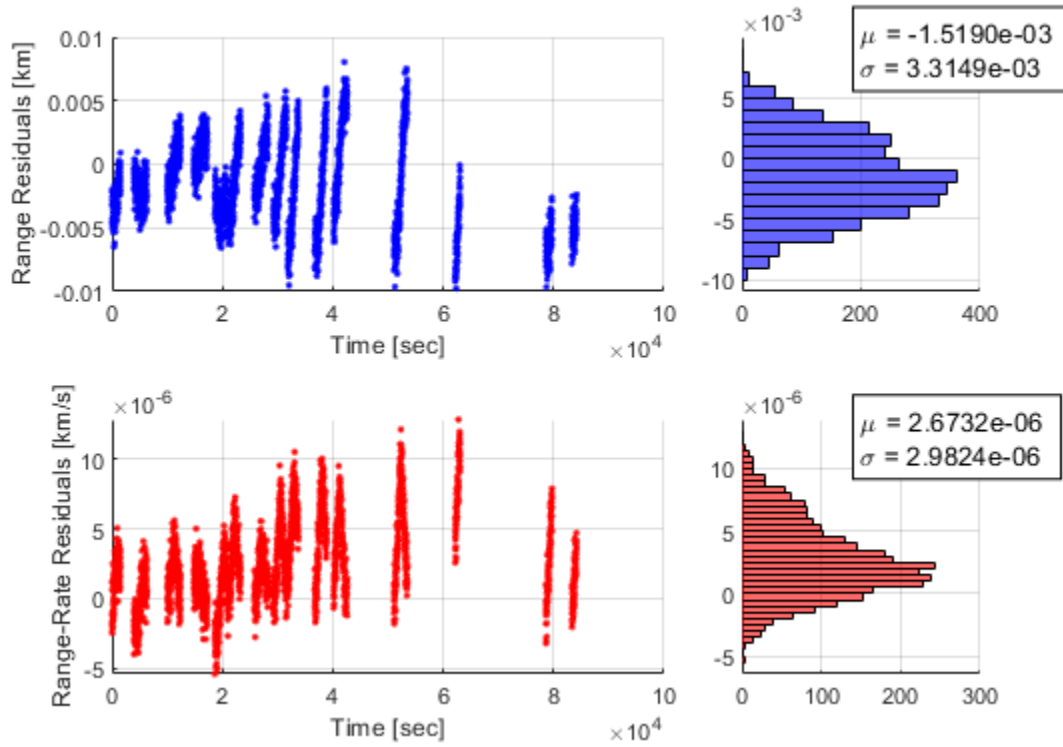
LKF Post-Fit Residuals - Run 3
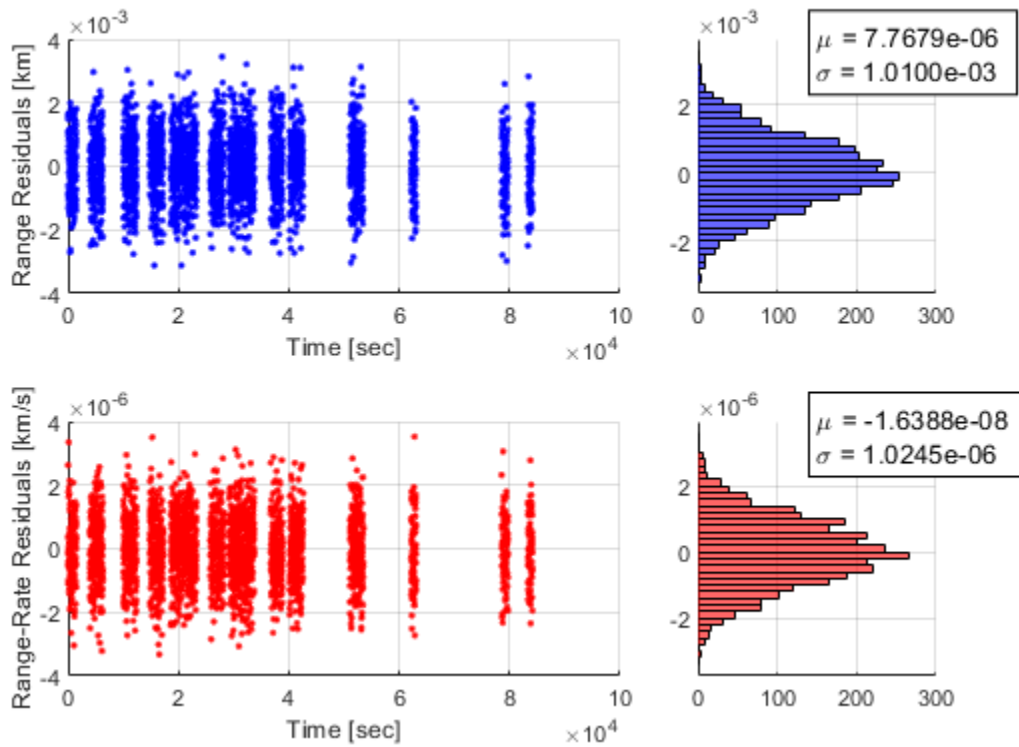
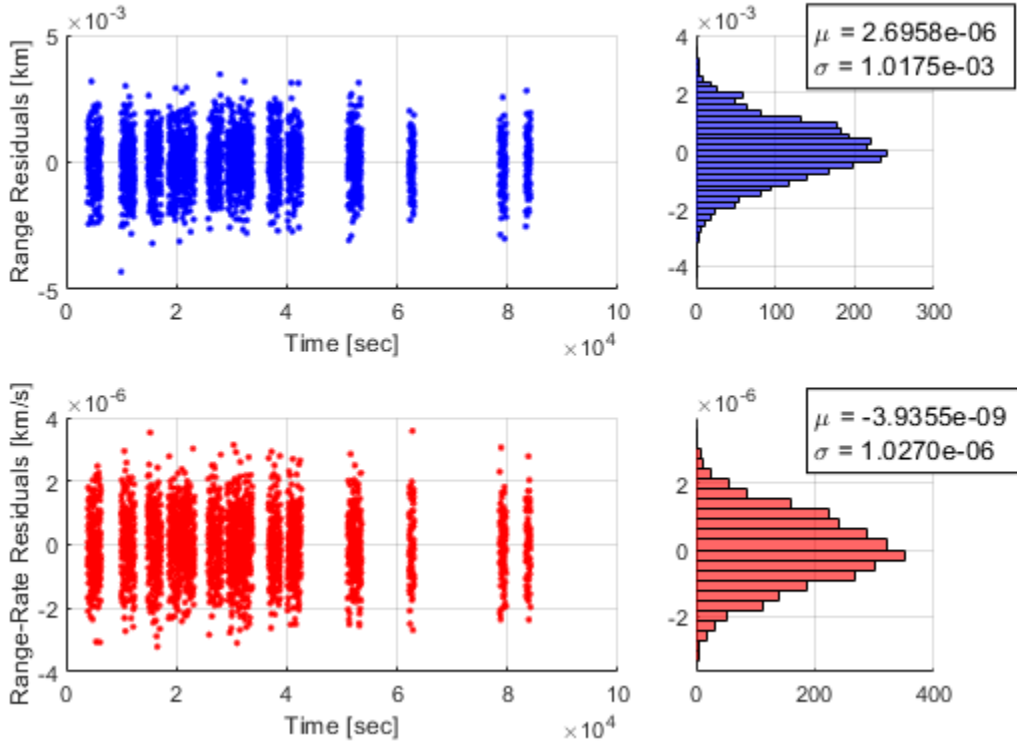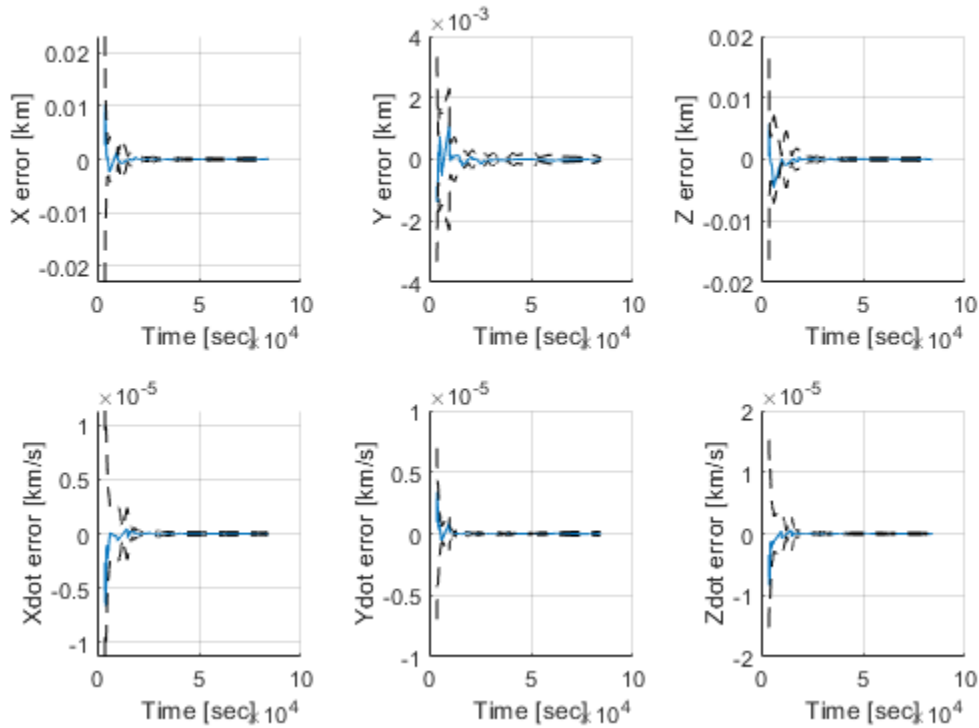LKF Post-Fit Residuals - Run 4

LKF Estimated State Error (X_{filt} - X_{ref})

EKF Post-Fit Residuals

EKF Estimated State Error ($X_{filt} - X_{ref}$)

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