

## Calibration results

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### Normalized Residuals

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Reprojection error (cam0): mean 0.103512759369, median 0.0866073840209, std: 0.0777440308941  
Reprojection error (cam1): mean 0.105192409174, median 0.0887114010436, std: 0.0809908657543  
Gyroscope error (imu0): mean 0.183580027215, median 0.14337365282, std: 0.161935769698  
Accelerometer error (imu0): mean 0.261783018834, median 0.226140625274, std: 0.183251748362

### Residuals

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Reprojection error (cam0) [px]: mean 0.103512759369, median 0.0866073840209, std: 0.0777440308941  
Reprojection error (cam1) [px]: mean 0.105192409174, median 0.0887114010436, std: 0.0809908657543  
Gyroscope error (imu0) [rad/s]: mean 0.0114118282805, median 0.00891249190209, std: 0.0100663630152  
Accelerometer error (imu0) [m/s<sup>2</sup>]: mean 0.147511885618, median 0.127427784268, std: 0.103260368316

### Transformation (cam0):

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T\_ci: (imu0 to cam0):

```
[[ 0.99998508 -0.00162086 0.00521714 0.00262298]
 [ 0.00158255 0.99997182 0.00733798 0.00217727]
 [-0.00522888 -0.00732961 0.99995947 -0.01850177]
 [ 0.      0.      0.      1.    ]]
```

T\_ic: (cam0 to imu0):

```
[[ 0.99998508 0.00158255 -0.00522888 -0.00272313]
 [-0.00162086 0.99997182 -0.00732961 -0.00230857]
 [ 0.00521714 0.00733798 0.99995947 0.01847136]
 [ 0.      0.      0.      1.    ]]
```

timeshift cam0 to imu0: [s] (t\_imu = t\_cam + shift)

0.00801364326483467

### Transformation (cam1):

-----

T\_ci: (imu0 to cam1):

```
[[ 0.99998021 -0.00189472 0.00599863 -0.04771077]
 [ 0.00185091 0.99997164 0.00729978 0.002146 ]
 [-0.00601229 -0.00728854 0.99995536 -0.01857657]
```

```
[ 0.    0.    0.    1.   ]]
```

T\_ic: (cam1 to imu0):

```
[[ 0.99998021  0.00185091 -0.00601229  0.04759417]
 [-0.00189472  0.99997164 -0.00728854 -0.00237173]
 [ 0.00599863  0.00729978  0.99995536  0.01884627]
 [ 0.    0.    0.    1.   ]]
```

timeshift cam1 to imu0: [s] (t\_imu = t\_cam + shift)

0.008011714256880343

Baselines:

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Baseline (cam0 to cam1):

```
[[ 0.99999966 -0.00026813  0.00078349 -0.05031867]
 [ 0.00026816  0.99999996 -0.0000396  -0.00003271]
 [-0.00078348  0.00003981  0.99999969 -0.00007283]
 [ 0.    0.    0.    1.   ]]
```

baseline norm: 0.050318734134735144 [m]

Gravity vector in target coords: [m/s<sup>2</sup>]

```
[-0.02223012 -9.74645326 -1.0837793 ]
```

Calibration configuration

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cam0

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Camera model: pinhole

Focal length: [384.35386606462447, 384.9560729180638]

Principal point: [319.28590839603237, 239.87334366520707]

Distortion model: radtan

Distortion coefficients: [0.003911246673083202, -0.0034005376214794316, 0.0004081791451489365, 0.0007181727055388892]

Type: aprilgrid

Tags:

Rows: 6

Cols: 6

Size: 0.048 [m]

Spacing 0.0144 [m]

cam1

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Camera model: pinhole

Focal length: [384.32186243851334, 384.9214612504451]

Principal point: [319.08615697476637, 239.98593476287843]

Distortion model: radtan

Distortion coefficients: [0.004378427247850674, -0.0041355241799928425, 0.0005900340360341945, 0.0002999052406894697]

Type: aprilgrid

Tags:

Rows: 6

Cols: 6

Size: 0.048 [m]

Spacing 0.0144 [m]

IMU configuration

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IMU0:

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Model: calibrated

Update rate: 500.0

Accelerometer:

Noise density: 0.0252

Noise density (discrete): 0.56348913033

Random walk: 0.000441

Gyroscope:

Noise density: 0.00278

Noise density (discrete): 0.0621626897745

Random walk: 1.65e-05

T\_i\_b

[[1. 0. 0. 0.]

[0. 1. 0. 0.]

[0. 0. 1. 0.]

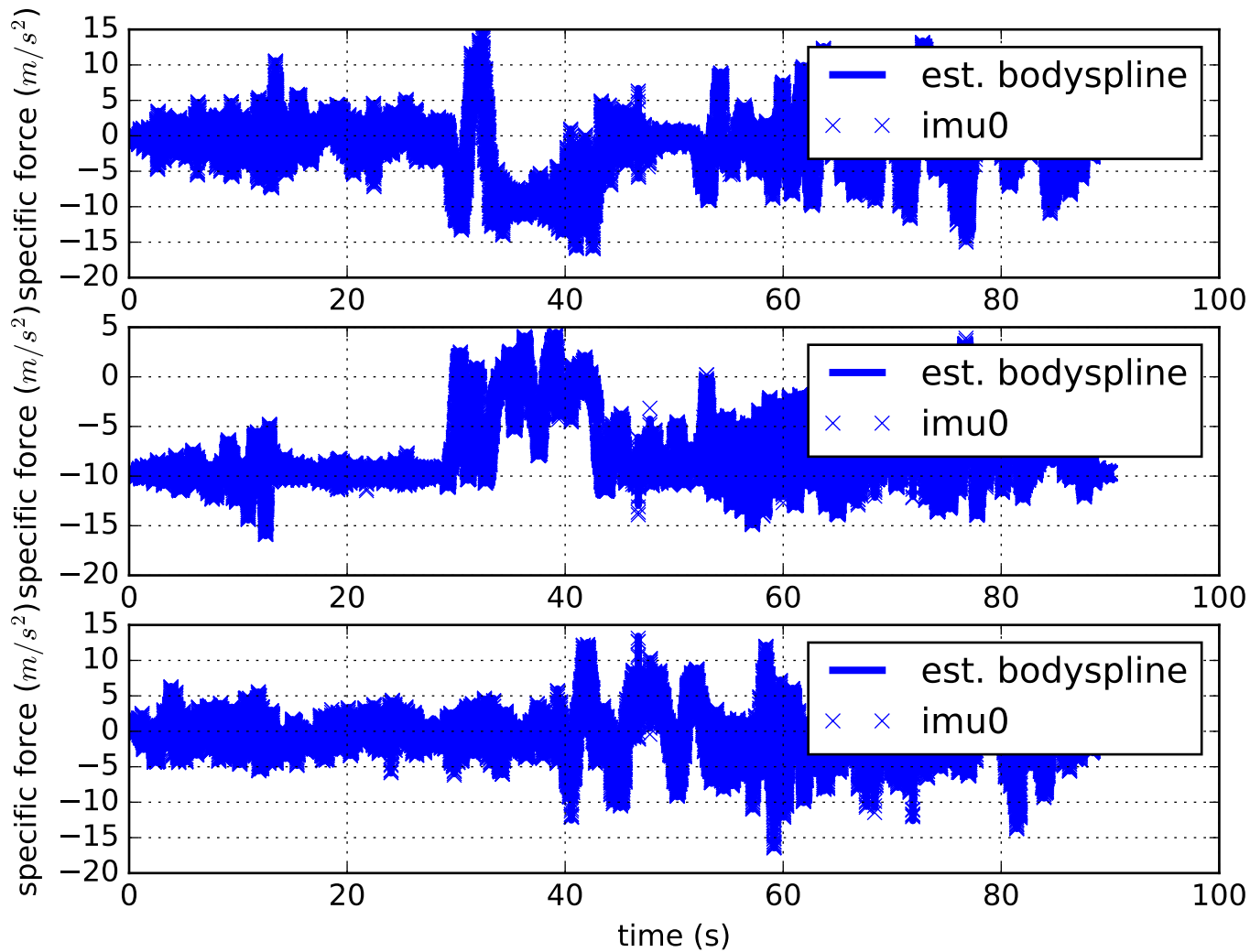
[0. 0. 0. 1.]]

time offset with respect to IMU0: 0.0 [s]

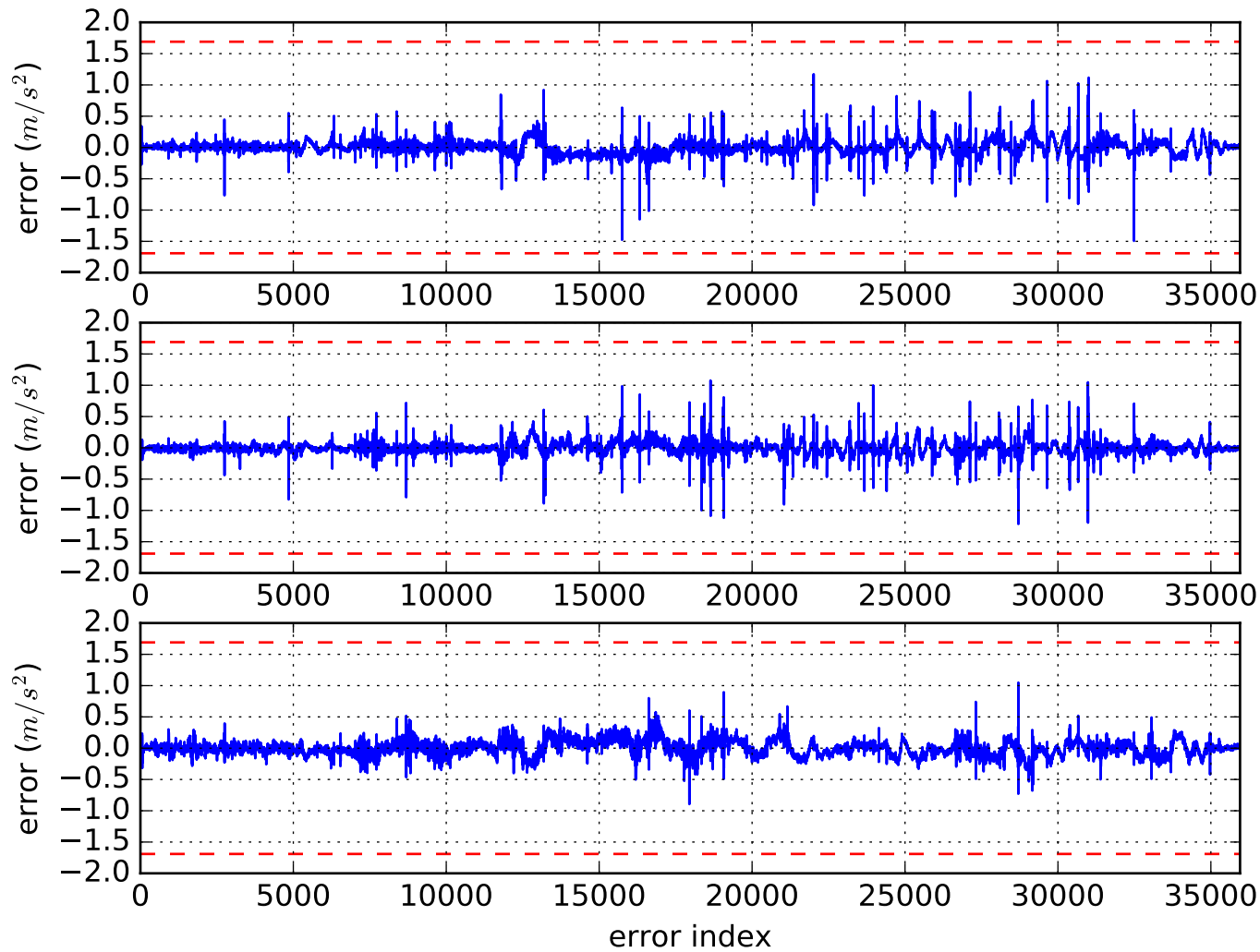




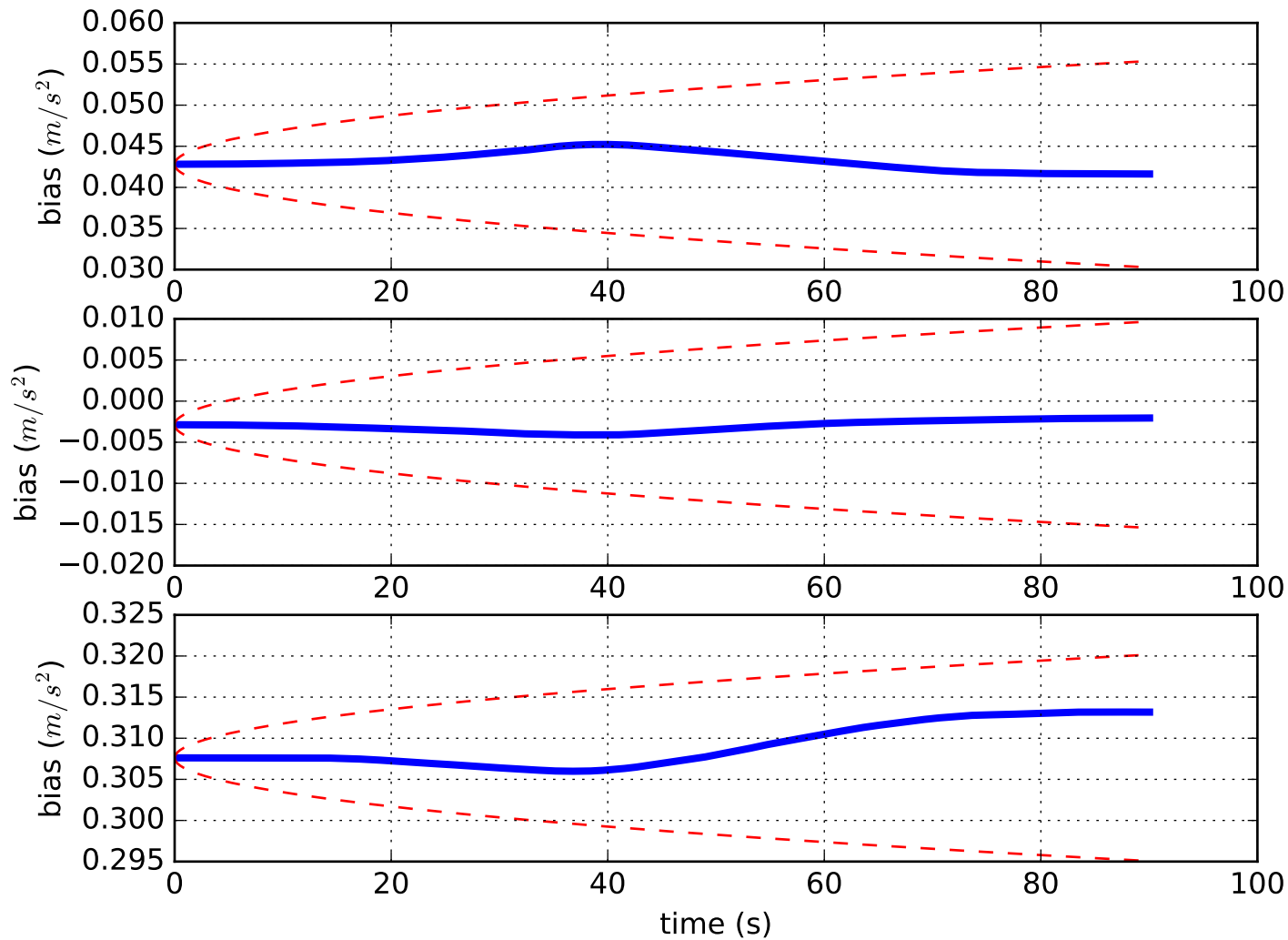
Comparison of predicted and measured specific force (imu0 frame)



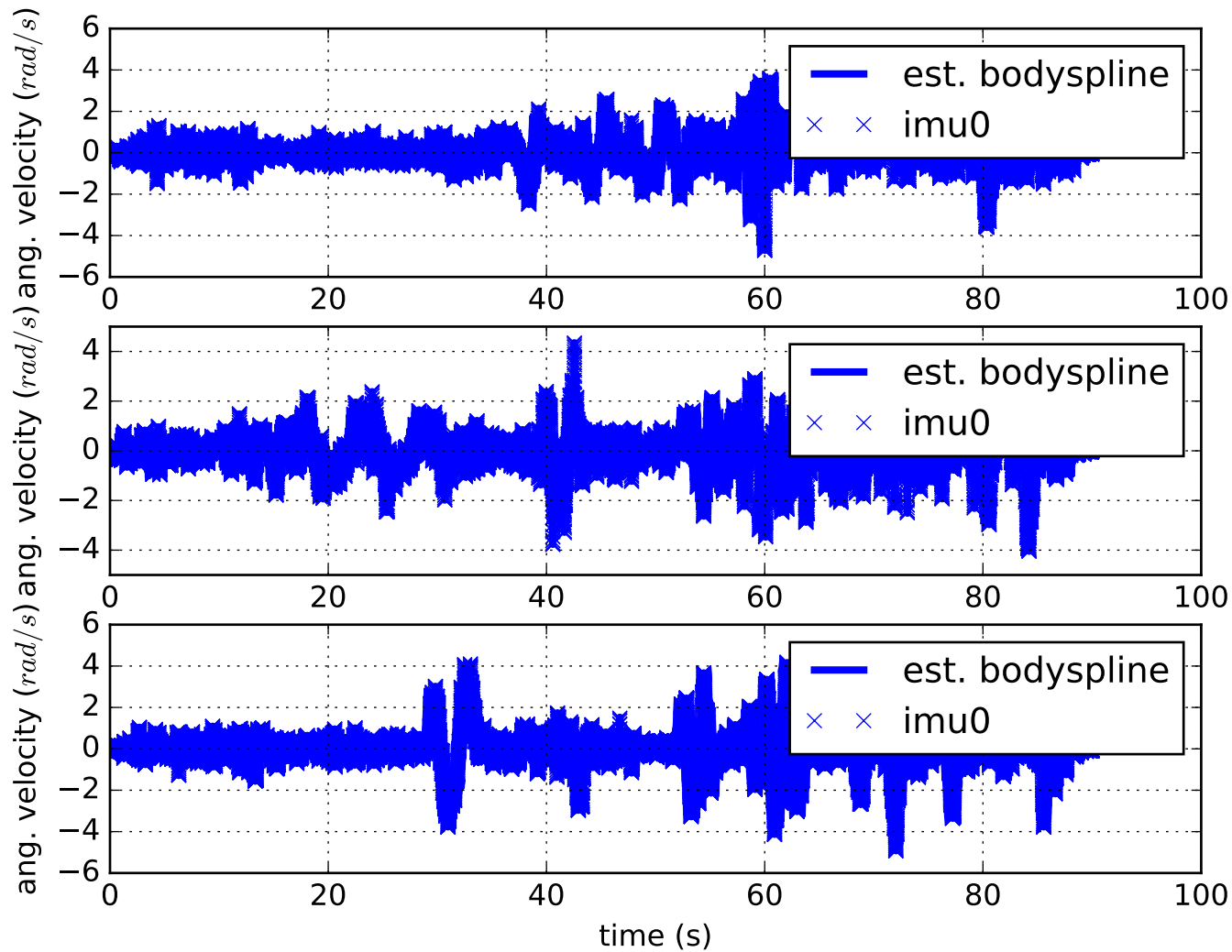
imu0: acceleration error



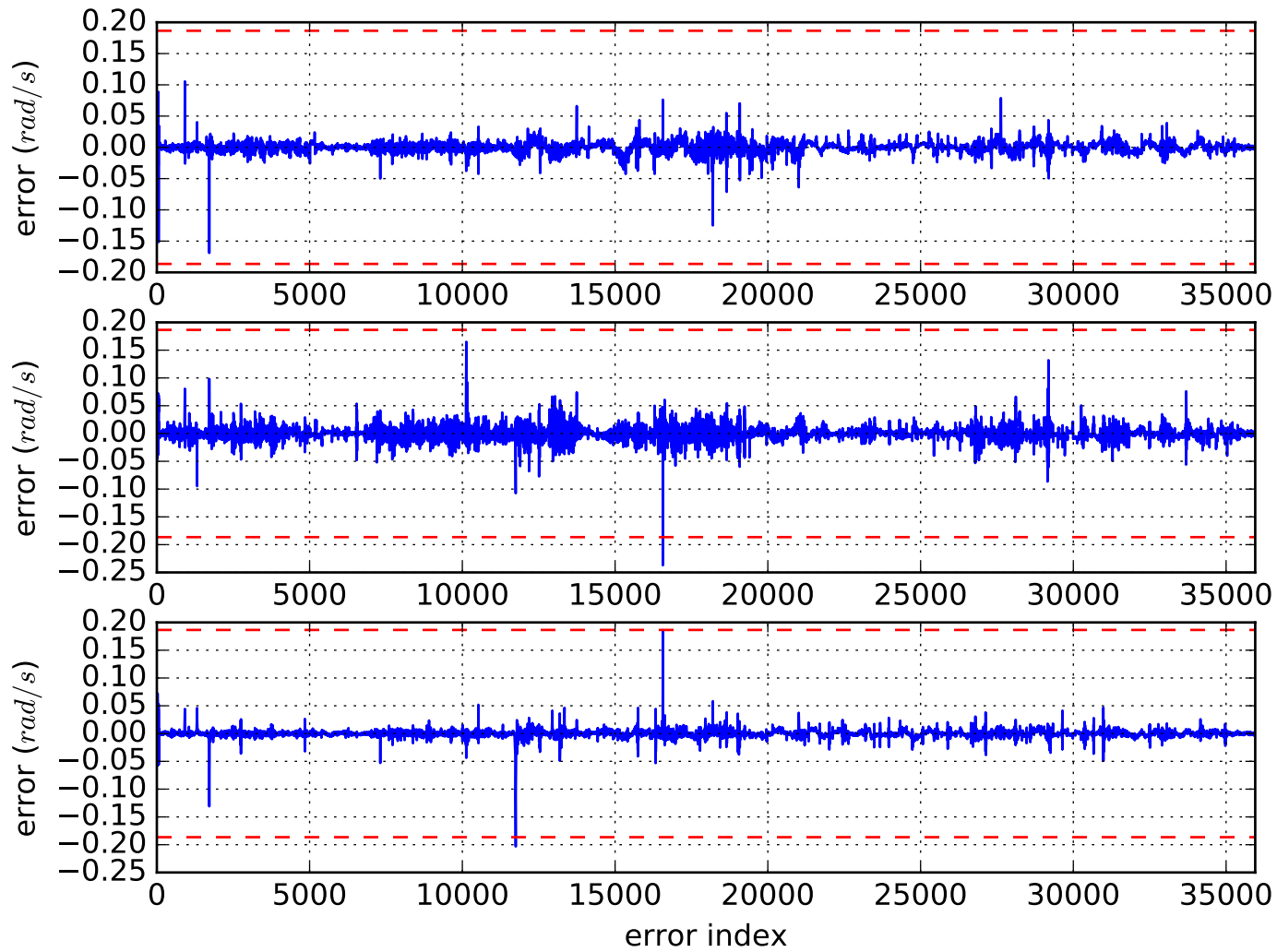
imu0: estimated accelerometer bias (imu frame)



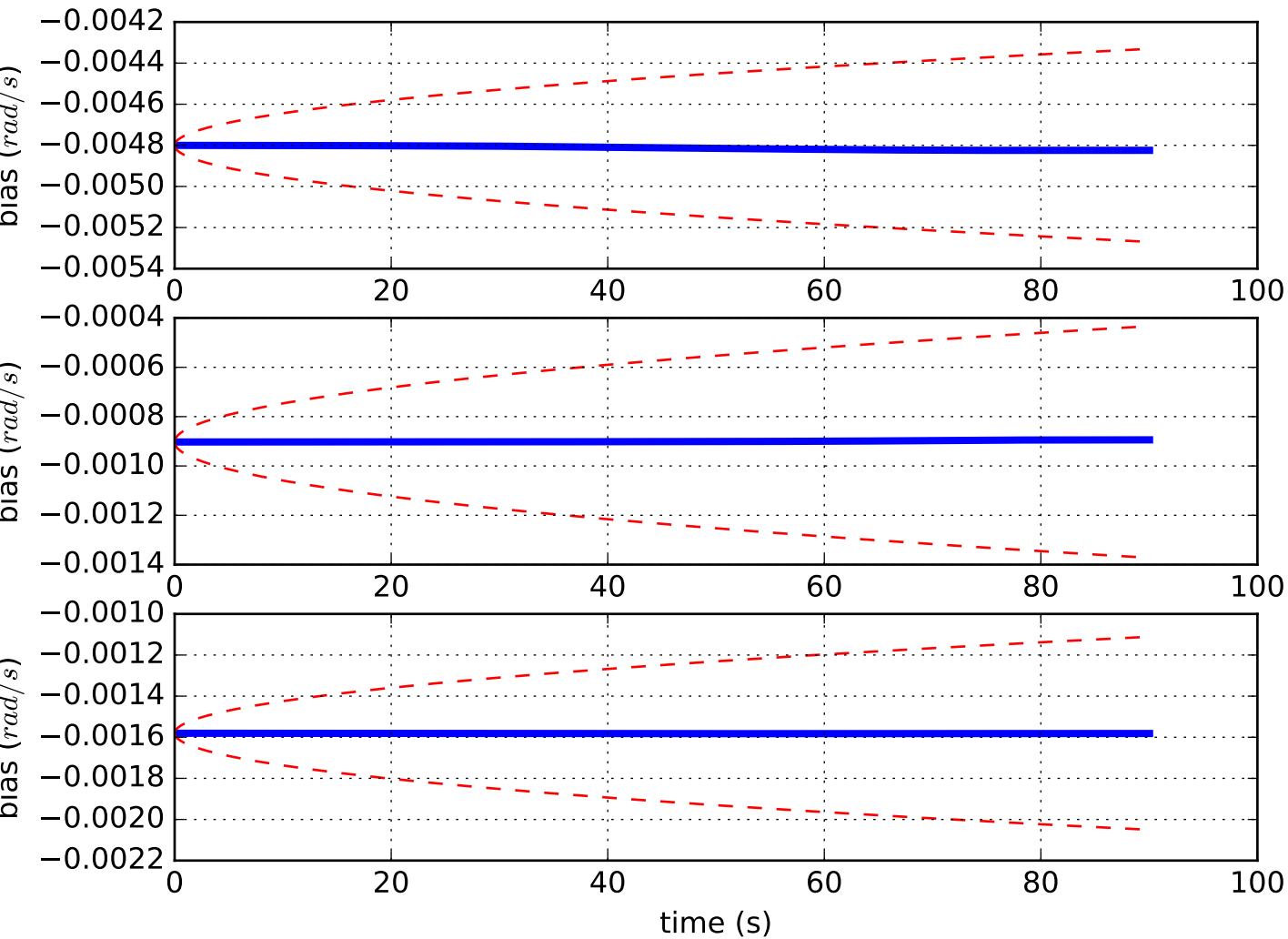
Comparison of predicted and measured angular velocities (body frame)



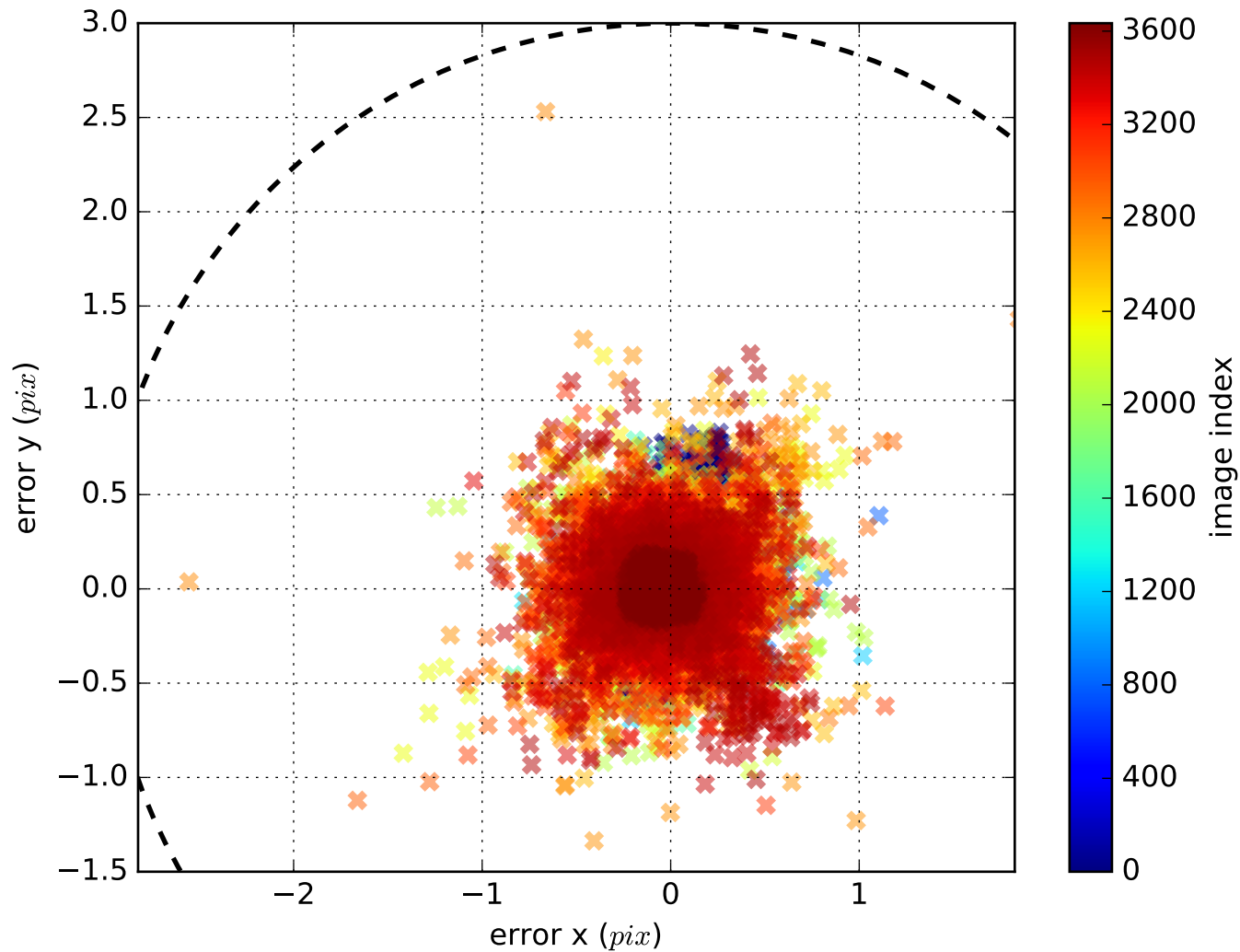
imu0: angular velocities error



imu0: estimated gyro bias (imu frame)



cam0: reprojection errors



cam1: reprojection errors

