

## Calibration results

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### Normalized Residuals

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Reprojection error (cam0): mean 0.0939591806842, median 0.0897653808334, std: 0.0471297656657  
Reprojection error (cam1): mean 0.0951201111853, median 0.090382870928, std: 0.0482771853494  
Gyroscope error (imu0): mean 0.492355871626, median 0.457753293123, std: 0.260809882769  
Accelerometer error (imu0): mean 0.581066153956, median 0.53486424318, std: 0.302719919025

### Residuals

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Reprojection error (cam0) [px]: mean 0.0939591806842, median 0.0897653808334, std: 0.0471297656657  
Reprojection error (cam1) [px]: mean 0.0951201111853, median 0.090382870928, std: 0.0482771853494  
Gyroscope error (imu0) [rad/s]: mean 0.00111407416187, median 0.00103577746457, std: 0.000590145397461  
Accelerometer error (imu0) [m/s^2]: mean 0.0230090457957, median 0.0211795434685, std: 0.0119870972224

### Transformation (cam0):

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T\_ci: (imu0 to cam0):

```
[[ -0.99952504  0.02961534 -0.00852233  0.04727988]
 [  0.00750192 -0.03439736 -0.99938008 -0.04744323]
 [ -0.02989013 -0.99896935  0.03415885 -0.06819996]
 [  0.          0.          0.          1.         ]]
```

T\_ic: (cam0 to imu0):

```
[[ -0.99952504  0.00750192 -0.02989013  0.04557484]
 [  0.02961534 -0.03439736 -0.99896935 -0.0711618 ]
 [ -0.00852233 -0.99938008  0.03415885 -0.04468125]
 [  0.          0.          0.          1.         ]]
```

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

0.0

### Transformation (cam1):

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T\_ci: (imu0 to cam1):

```
[[ -0.99951105  0.03029912 -0.00772188 -0.05369743]
 [  0.00810408  0.01251164 -0.99988889 -0.04613174]
 [ -0.03019914 -0.99946257 -0.01275107 -0.07149261]
```

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

T\_ic: (cam1 to imu0):

```
[[-0.99951105  0.00810408 -0.03019914 -0.05545634]
```

```
[ 0.03029912  0.01251164 -0.99946257 -0.06925002]
```

```
[-0.00772188 -0.99988889 -0.01275107 -0.04745286]
```

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

timeshift cam1 to imu0: [s] ( $t_{imu} = t_{cam} + \text{shift}$ )

0.0

Baselines:

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Baseline (cam0 to cam1):

```
[[ 0.99999945 -0.00082336 -0.00065614 -0.1010611 ]
```

```
[ 0.00079169  0.99889946 -0.04689604 -0.00197646]
```

```
[ 0.00069403  0.04689549  0.99889956 -0.00117564]
```

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

baseline norm: 0.101087264328 [m]

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

```
[ 0.03410895 -9.69438391 -1.47857369]
```

Calibration configuration

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cam0

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Camera model: pinhole

Focal length: [190.97847715128717, 190.9733070521226]

Principal point: [254.93170605935475, 256.8974428996504]

Distortion model: equidistant

Distortion coefficients: [0.0034823894022493434, 0.0007150348452162257, -0.0020532361418706202, 0.00020293673591811182]

Type: aprilgrid

Tags:

Rows: 6

Cols: 6

Size: 0.088 [m]

Spacing 0.0264 [m]

cam1

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Camera model: pinhole

Focal length: [190.44236969414825, 190.4344384721956]

Principal point: [252.59949716835982, 254.91723064636983]

Distortion model: equidistant

Distortion coefficients: [0.0034003170790442797, 0.001766278153469831, -0.00266312569781606, 0.0003299517423931039]

Type: aprilgrid

Tags:

Rows: 6

Cols: 6

Size: 0.088 [m]

Spacing 0.0264 [m]

IMU configuration

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IMU0:

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Model: calibrated

Update rate: 200.0

Accelerometer:

Noise density: 0.0028

Noise density (discrete): 0.0395979797464

Random walk: 0.00086

Gyroscope:

Noise density: 0.00016

Noise density (discrete): 0.0022627416998

Random walk: 2.2e-05

T\_i\_b

[[ 1. 0. 0. 0.]

[ 0. 1. 0. 0.]

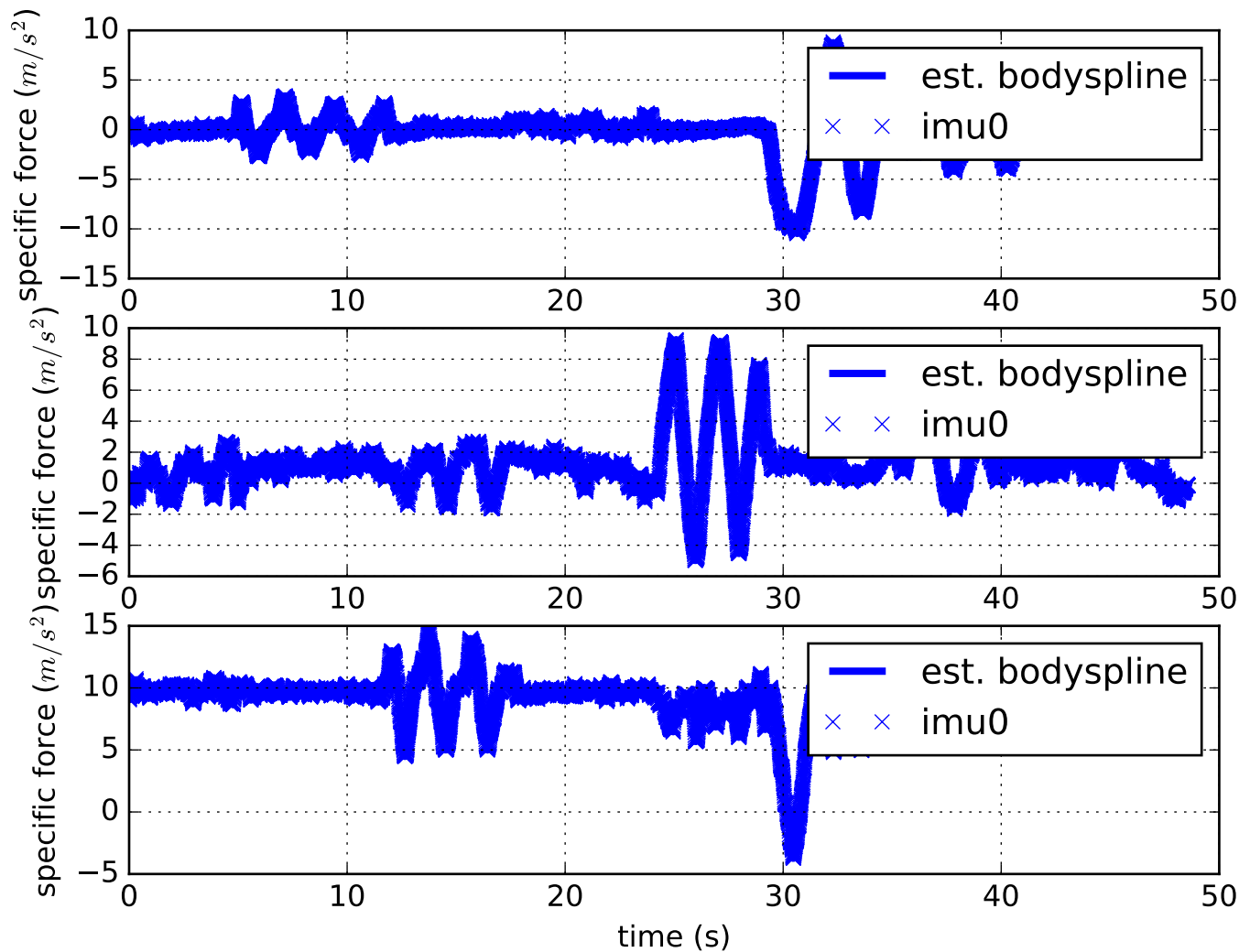
[ 0. 0. 1. 0.]

[ 0. 0. 0. 1.]]

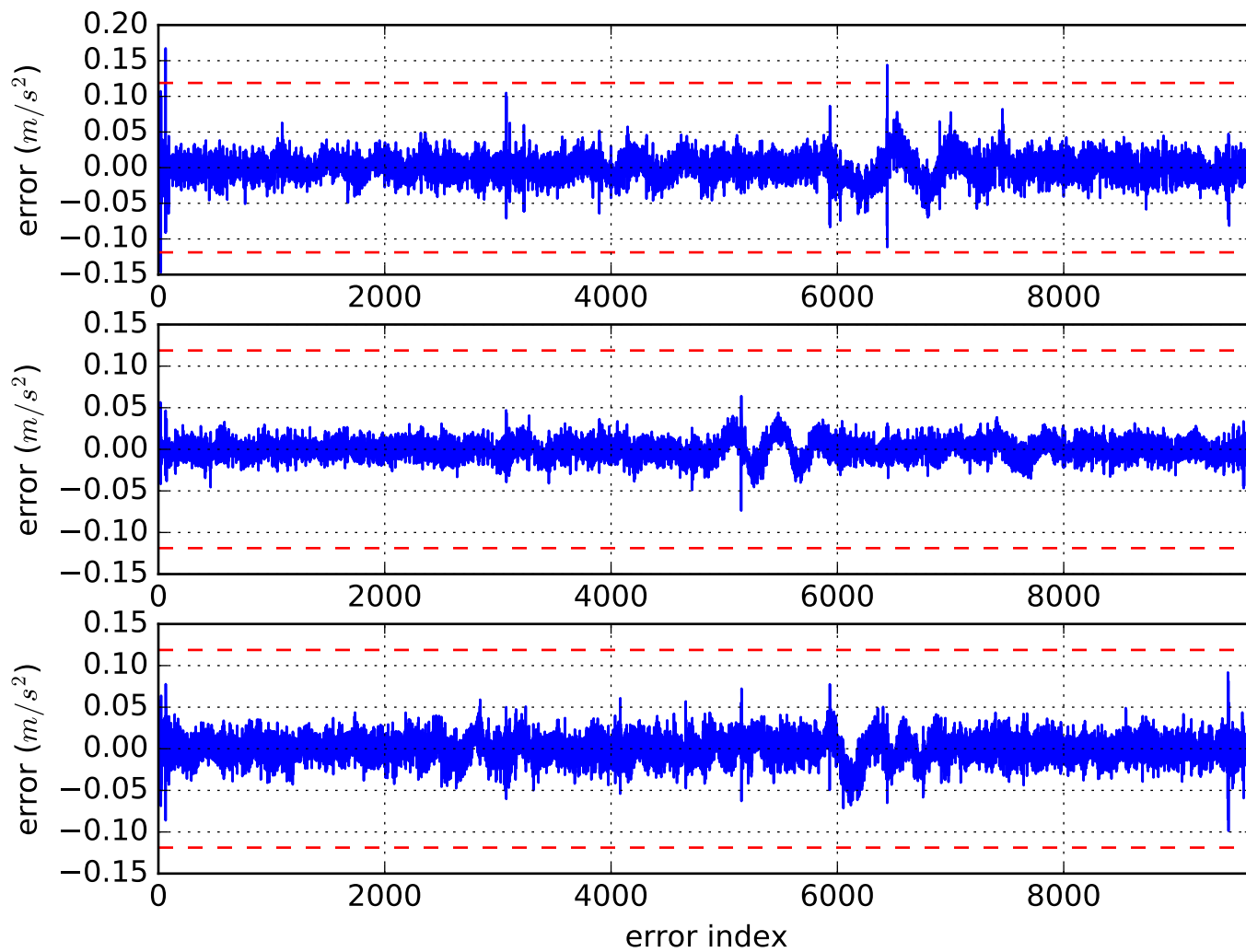
time offset with respect to IMU0: 0.0 [s]



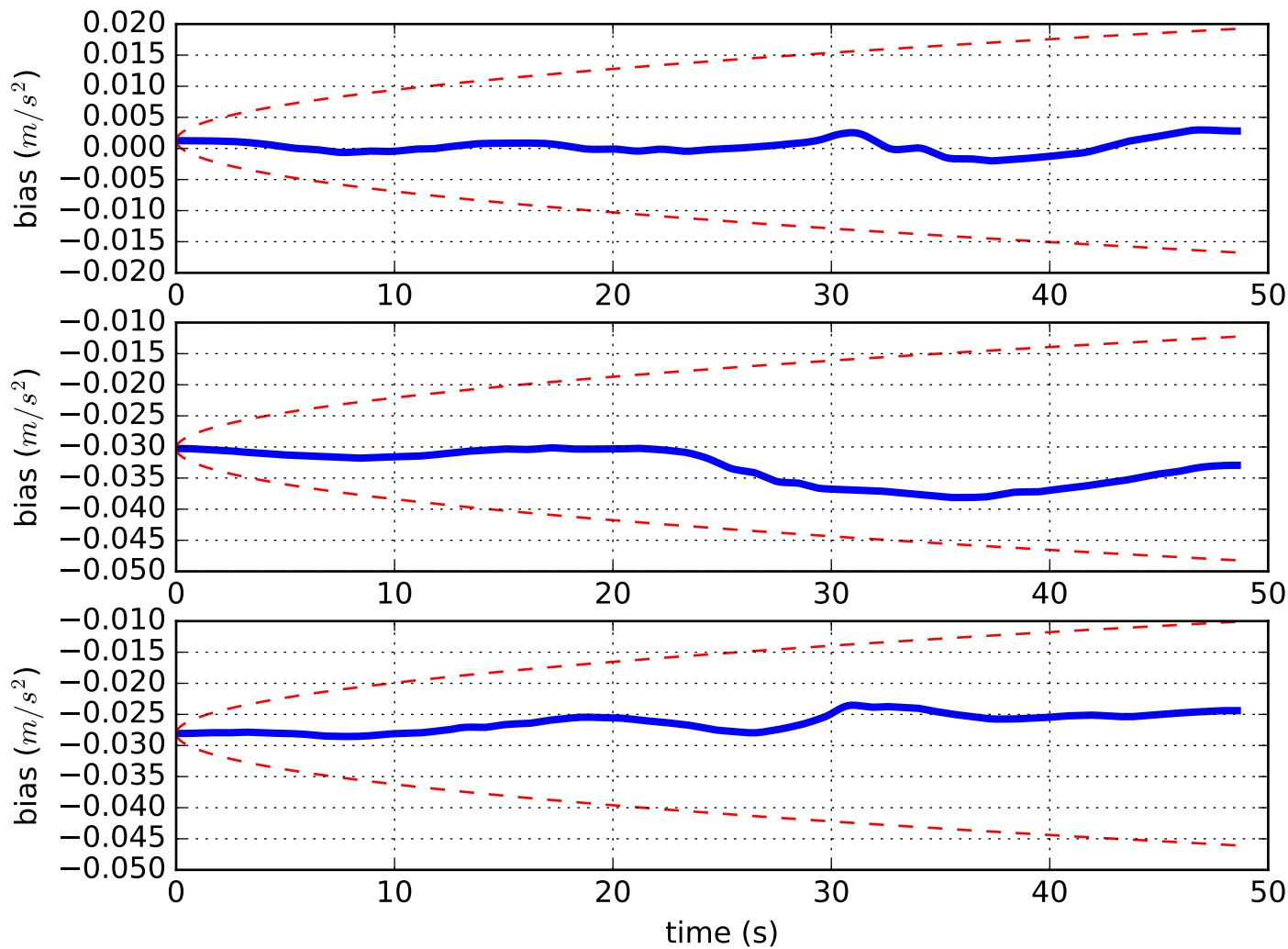
Comparison of predicted and measured specific force (imu0 frame)



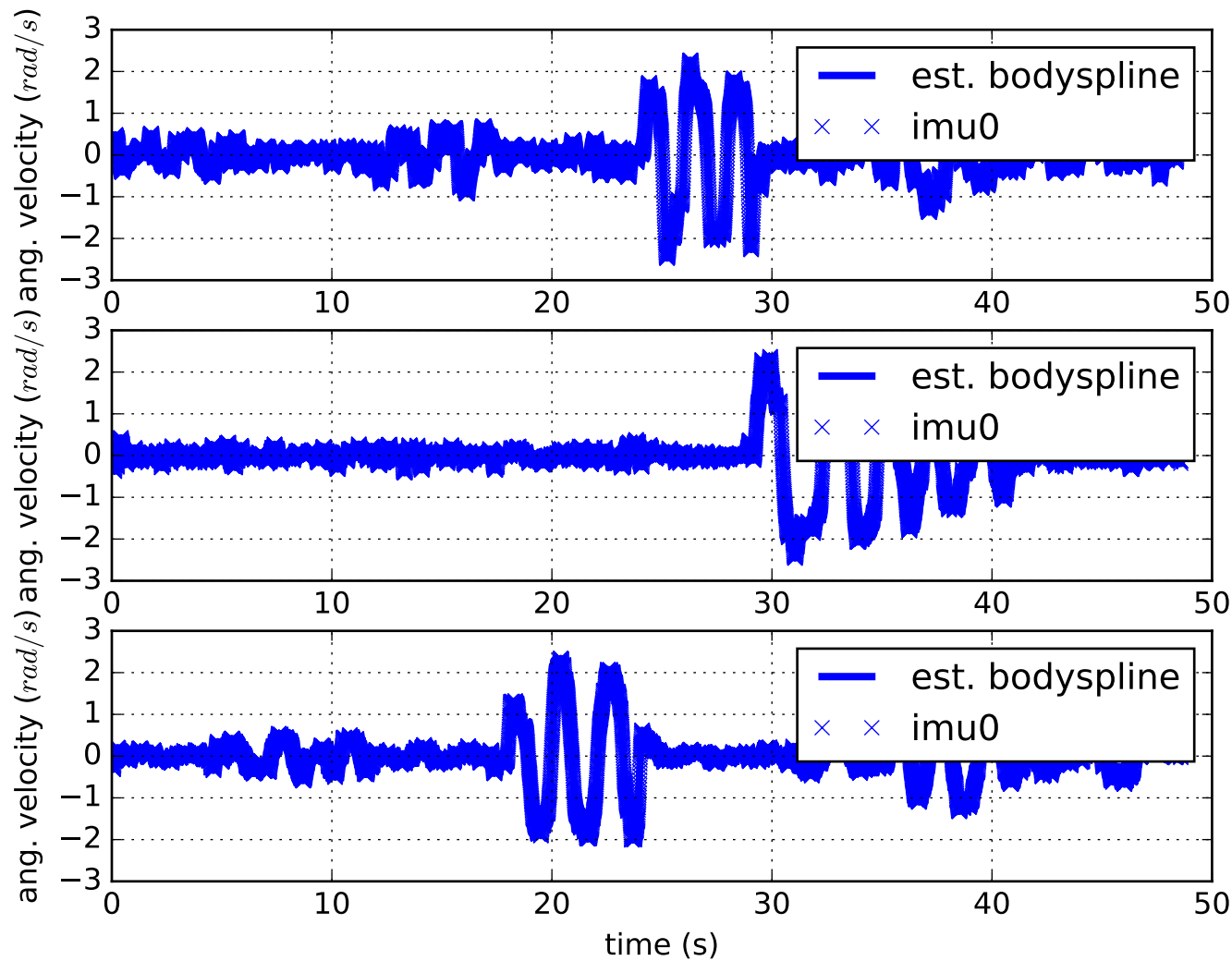
imu0: acceleration error



imu0: estimated accelerometer bias (imu frame)

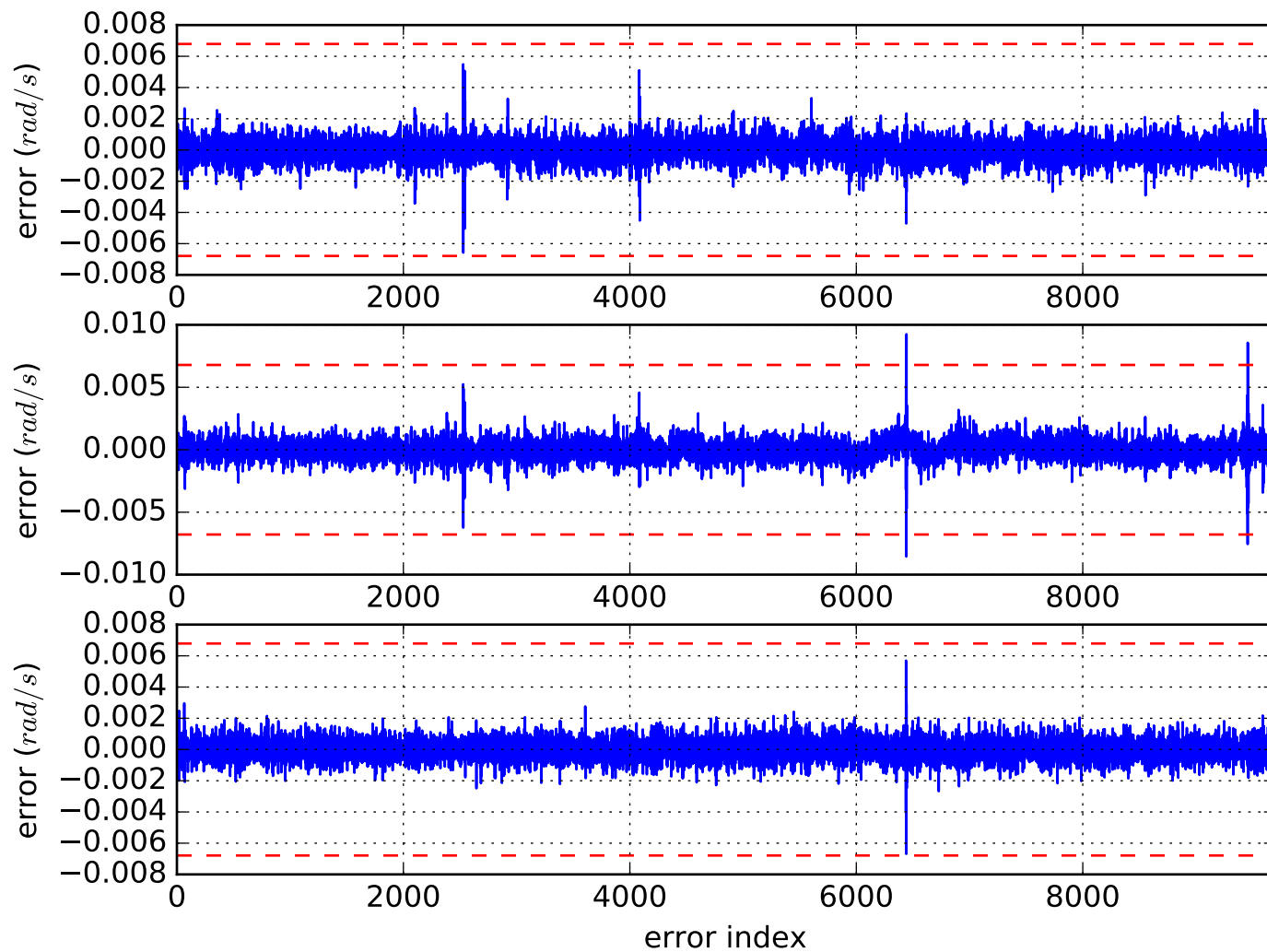


Comparison of predicted and measured angular velocities (body frame)

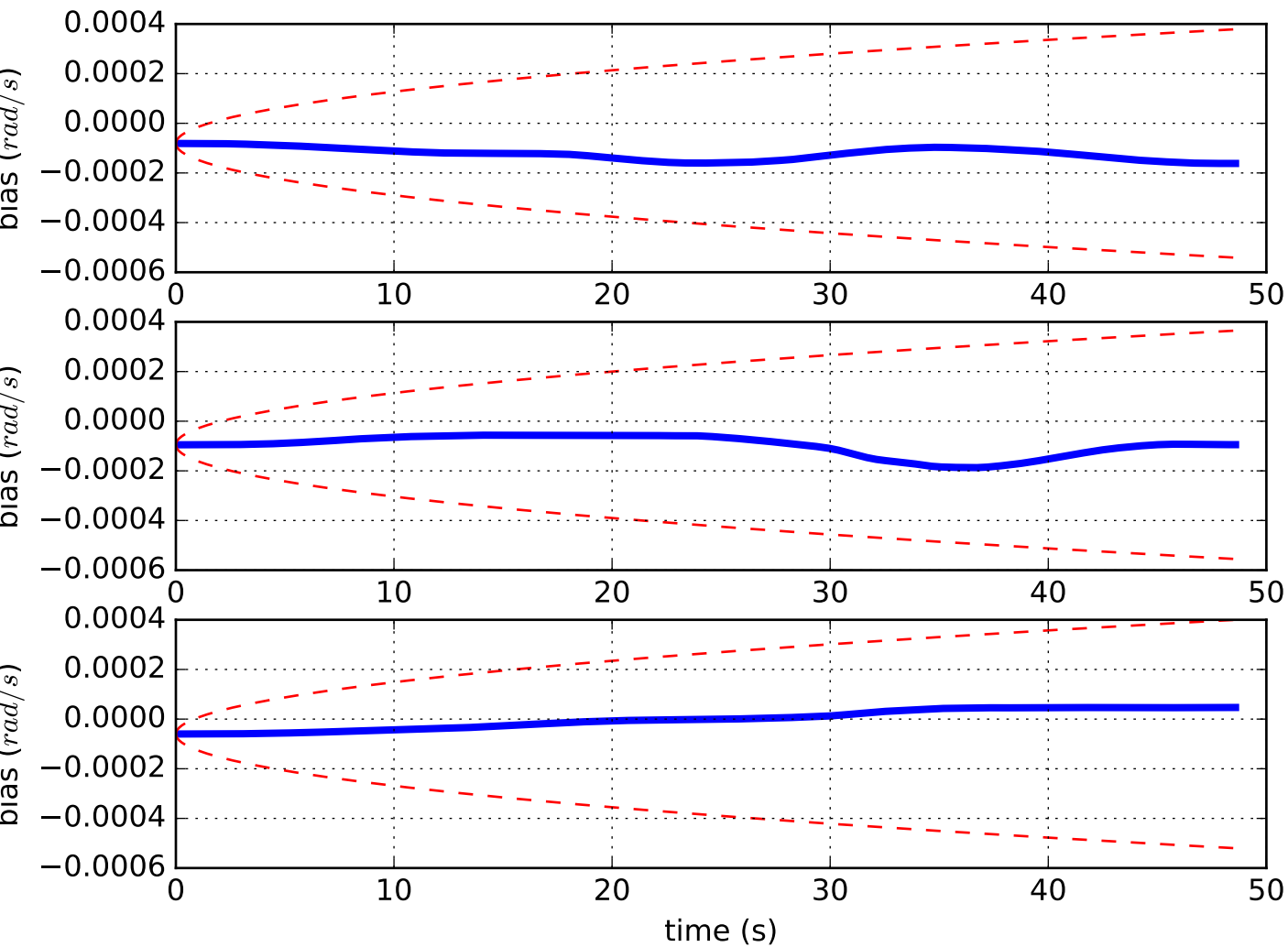




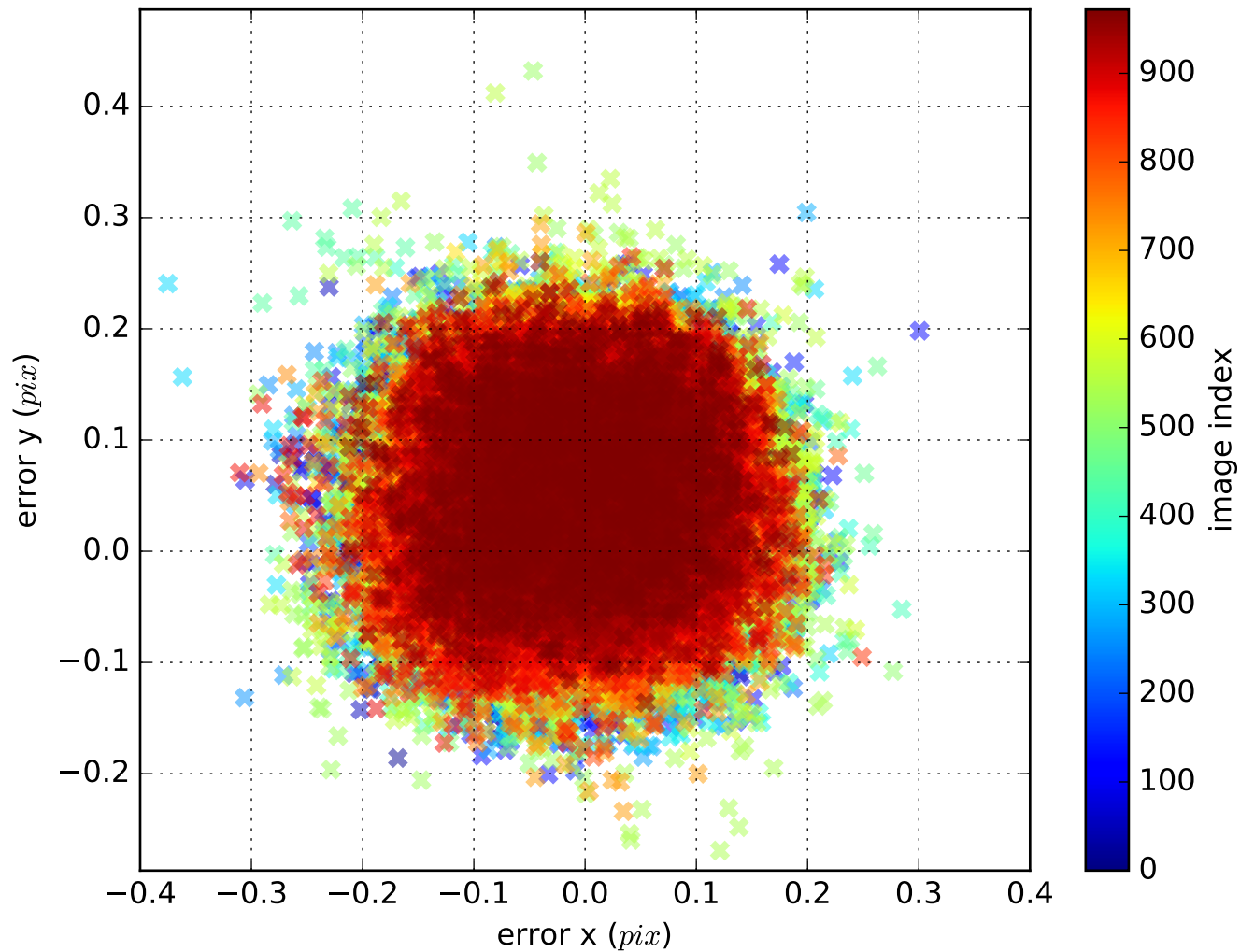
imu0: angular velocities error



imu0: estimated gyro bias (imu frame)



cam0: reprojection errors



cam1: reprojection errors

