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# Visualize the EEG output from the PREP processing pipeline.

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Calling directly: prepPipelineReport

This helper reporting script expects that EEG will be in the base workspace with an EEG.etc.noiseDetection structure containing the report. It also expects the following variables in the base workspace:

- summaryReportName name of the summary report
- summaryFolder folder where summary report goes
- sessionFolder folder where specific report goes
- sessionReportName name of individual report

- `relativeReportLocation` report location relative to summary

The reporting function appends a summary to the summary report.

Usually the `prepPipelineReport` script is called through the function:

```
publishPrepPipelineReport
```

## Write data status and report header

```
RSVP Study, session 15, task main, recording 1[289 channels, 1121792 frame
Error status: good
Versions:
  Detrend:v0.48 GlobalTrend:v0.48 LineNoise:v0.48 Resampling:v0.48 Referenc
Sampling rate: 256Hz
Events: 26514, Original events: 26514
Unique event types: 7
Bad channels interpolated for reference: []
```

## Line noise removal step

```
Version v0.48
Sampling frequency Fs: 256 Hz
Line noise frequencies:
  [ 60 120 ]
Maximum iterations: 10
Significant frequency p-value: 0.01
+/- frequency BW for significant peaks (fScanBandWidth): 2
Taper bandwidth: 2 Hz
Taper window size (seconds): 4
Taper step size (seconds): 1
Sigmoidal smoothing factor (tau): 100
Spectral pad factor: 0
Analysis frequency interval(fPassBand): [ 0, 128 ] Hz
Taper template: [ 1, 4, 1 ]
Line noise channels (256 channels):
  [ 1 2 3 4 5 6 7 8 9 10
    11 12 13 14 15 16 17 18 19 20
    21 22 23 24 25 26 27 28 29 30
    31 32 33 34 35 36 37 38 39 40
    41 42 43 44 45 46 47 48 49 50
    51 52 53 54 55 56 57 58 59 60
    61 62 63 64 65 66 67 68 69 70
    71 72 73 74 75 76 77 78 79 80
    81 82 83 84 85 86 87 88 89 90
    91 92 93 94 95 96 97 98 99 100
    101 102 103 104 105 106 107 108 109 110
    111 112 113 114 115 116 117 118 119 120
    121 122 123 124 125 126 127 128 129 130
    131 132 133 134 135 136 137 138 139 140
    141 142 143 144 145 146 147 148 149 150
    151 152 153 154 155 156 157 158 159 160
```

```
161 162 163 164 165 166 167 168 169 170
171 172 173 174 175 176 177 178 179 180
181 182 183 184 185 186 187 188 189 190
191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210
211 212 213 214 215 216 217 218 219 220
221 222 223 224 225 226 227 228 229 230
231 232 233 234 235 236 237 238 239 240
241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 ]
```

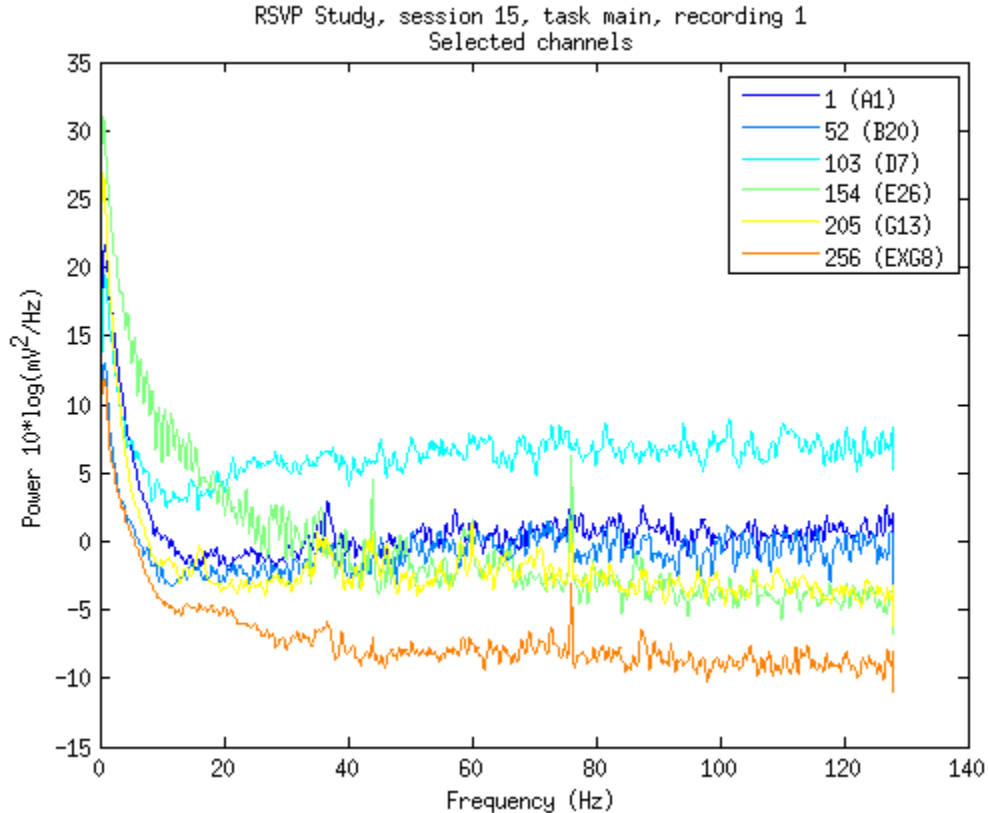
## Initial detrend for reference calculation

```
Detrend version v0.48
Detrend cutoff: 1 Hz
Detrend type: high pass
Detrend step size: 2.000000e-02
Detrend command:
EEG1 = pop_eegfiltnew(EEG1, [], 1, 846, true, [], 0);
Detrended channels (256 channels):
[ 1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
91 92 93 94 95 96 97 98 99 100
101 102 103 104 105 106 107 108 109 110
111 112 113 114 115 116 117 118 119 120
121 122 123 124 125 126 127 128 129 130
131 132 133 134 135 136 137 138 139 140
141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160
161 162 163 164 165 166 167 168 169 170
171 172 173 174 175 176 177 178 179 180
181 182 183 184 185 186 187 188 189 190
191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210
211 212 213 214 215 216 217 218 219 220
221 222 223 224 225 226 227 228 229 230
231 232 233 234 235 236 237 238 239 240
241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 ]
```

## Spectrum after line noise and detrend

*pop\_eegfiltnew()* - performing 847 point highpass filtering.

```
pop_eegfiltnew() - transition band width: 1 Hz  
  
pop_eegfiltnew() - passband edge(s): 1 Hz  
pop_eegfiltnew() - cutoff frequency(ies) (-6 dB): 0.5 Hz  
pop_eegfiltnew() - filtering the data  
firfilt(): |=====| 100%, ETE 00:00
```



## Report referencing step

```
Referencing version v0.48  
Reference type robust  
Interpolation order post-reference
```

```
Reference channels (248 channels):  
[ 1 2 3 4 5 6 7 8 9 10  
11 12 13 14 15 16 17 18 19 20  
21 22 23 24 25 26 27 28 29 30  
31 32 33 34 35 36 37 38 39 40  
41 42 43 44 45 46 47 48 49 50  
51 52 53 54 55 56 57 58 59 60  
61 62 63 64 65 66 67 68 69 70  
71 72 73 74 75 76 77 78 79 80  
81 82 83 84 85 86 87 88 89 90  
91 92 93 94 95 96 97 98 99 100  
101 102 103 104 105 106 107 108 109 110  
111 112 113 114 115 116 117 118 119 120
```

Visualize the EEG output from  
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```
121 122 123 124 125 126 127 128 129 130
131 132 133 134 135 136 137 138 139 140
141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160
161 162 163 164 165 166 167 168 169 170
171 172 173 174 175 176 177 178 179 180
181 182 183 184 185 186 187 188 189 190
191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210
211 212 213 214 215 216 217 218 219 220
221 222 223 224 225 226 227 228 229 230
231 232 233 234 235 236 237 238 239 240
241 242 243 244 245 246 247 248 ]
```

*Evaluation channels (248 channels):*

```
[ 1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
91 92 93 94 95 96 97 98 99 100
101 102 103 104 105 106 107 108 109 110
111 112 113 114 115 116 117 118 119 120
121 122 123 124 125 126 127 128 129 130
131 132 133 134 135 136 137 138 139 140
141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160
161 162 163 164 165 166 167 168 169 170
171 172 173 174 175 176 177 178 179 180
181 182 183 184 185 186 187 188 189 190
191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210
211 212 213 214 215 216 217 218 219 220
221 222 223 224 225 226 227 228 229 230
231 232 233 234 235 236 237 238 239 240
241 242 243 244 245 246 247 248 ]
```

*RereferencedChannels (256 channels):*

```
[ 1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
91 92 93 94 95 96 97 98 99 100
101 102 103 104 105 106 107 108 109 110
111 112 113 114 115 116 117 118 119 120
```

```
121 122 123 124 125 126 127 128 129 130
131 132 133 134 135 136 137 138 139 140
141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160
161 162 163 164 165 166 167 168 169 170
171 172 173 174 175 176 177 178 179 180
181 182 183 184 185 186 187 188 189 190
191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210
211 212 213 214 215 216 217 218 219 220
221 222 223 224 225 226 227 228 229 230
231 232 233 234 235 236 237 238 239 240
241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 ]

Noisy channel detection parameters:
Robust deviation threshold (z score): 5
High frequency noise threshold (ratio): 5
Correlation window size (in seconds): 1
Correlation threshold (with any channel): 0.4
Bad correlation threshold: 0.01
(fraction of time with low correlation or dropout)
Ransac off (if 1 Ransac turned off) : 0
Ransac sample size : 50
(number channels to use for interpolated estimate)
Ransac channel fraction (for ransac sample size): 0.25
RansacCorrelationThreshold: 0.75
RansacUnbrokenTime (input parameter): 0.4
RansacWindowSeconds (in seconds): 5
RansacPerformed (if 1, Ransac on and enough channels): 1
Maximum reference iterations: 4
Actual reference iterations: 2

Bad channels interpolated:
[ 4(A4) 26(A26) 27(A27) 30(A30) 31(A31) 96(C32) 99(D3) 100(D4) 107(D11)
109(D13) 111(D15) 114(D18) 118(D22) 121(D25) 122(D26) 149(E21) 151(E23)
159(E31) 171(F11) 173(F13) 174(F14) 201(G9) 215(G23) 225(H1) 232(H8) 233
235(H11) 236(H12) 237(H13) 238(H14) 239(H15) 240(H16) 241(H17) 242(H18)
245(H21) 246(H22) 247(H23) 248(H24) ]

Bad because of NaN:
[ ]

Bad because data is constant:
[ ]

Bad because of low SNR:
[ 96(C32) 109(D13) 149(E21) 151(E23) 159(E31) ]

Bad because of drop outs:
[ ]

Bad because of poor max correlation:
[ 4(A4) 26(A26) 27(A27) 30(A30) 31(A31) 100(D4) 107(D11) 111(D15) 118(D2
171(F11) 173(F13) 174(F14) 201(G9) 215(G23) 232(H8) 233(H9) 234(H10) 238
241(H17) 242(H18) ]

Bad because of large deviation:
[ 4(A4) 99(D3) 100(D4) 108(D12) 114(D18) 121(D25) 225(H1) 233(H9) 234(H1
236(H12) 237(H13) 238(H14) 239(H15) 240(H16) 241(H17) 242(H18) 243(H19)
```

```
246(H22) 247(H23) 248(H24) ]
Bad because of HF noise:
[ ]
Bad because of poor Ransac predictability :
[ 96(C32) 109(D13) 149(E21) 151(E23) 152(E24) 157(E29) 159(E31) ]

Bad channels after interpolation+referencing:
[ 3(A3) 231(H7) ]
Bad because of NaN:
[ ]
Bad because data is constant:
[ ]
Bad because of low SNR:
[ ]
Bad because of drop outs:
[ ]
Bad because of poor max correlation:
[ ]
Bad because of large deviation:
[ 3(A3) 231(H7) ]
Bad because of HF noise:
[ ]
Bad because of poor Ransac predictability :
[ ]

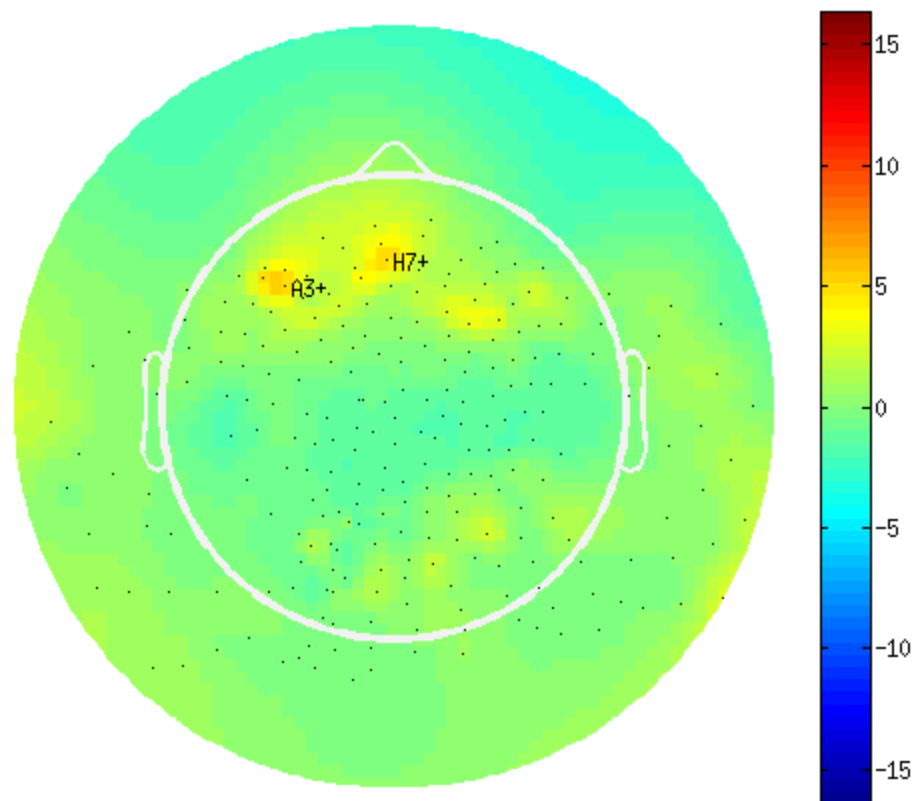
Actual interpolation iterations: 2
```

## Robust channel deviation (referenced)

```
Noisy channel legend: NaN: n
NoData: z
LowSNR: s
Corr: c
Amp: +
Noise: x
Ran: ?
```

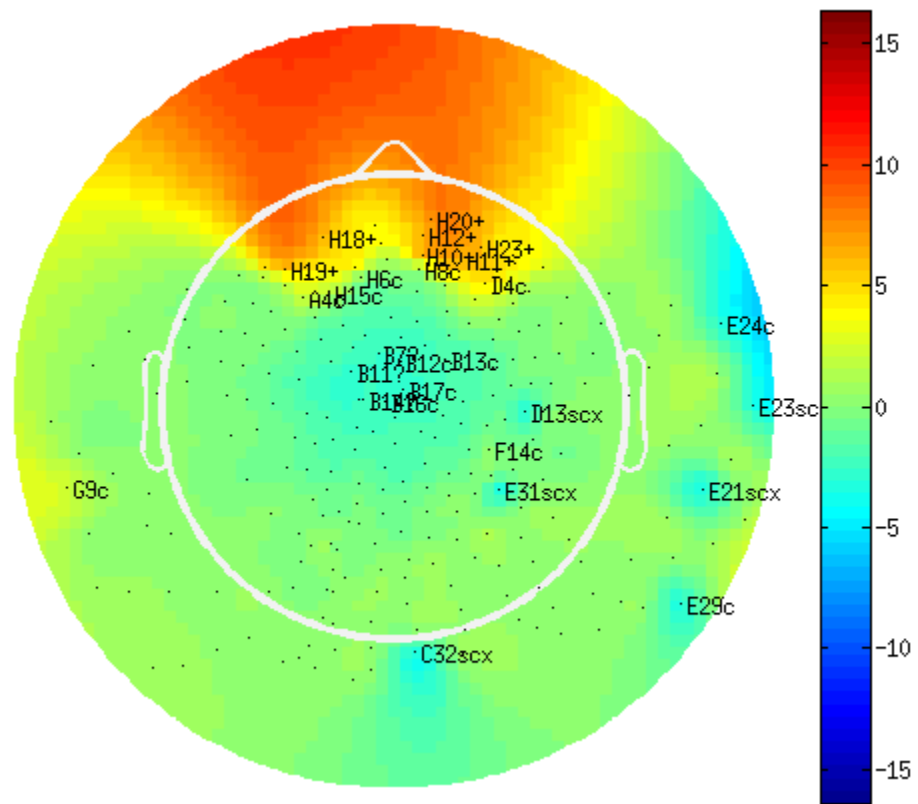
Visualize the EEG output from  
the PREP processing pipeline.

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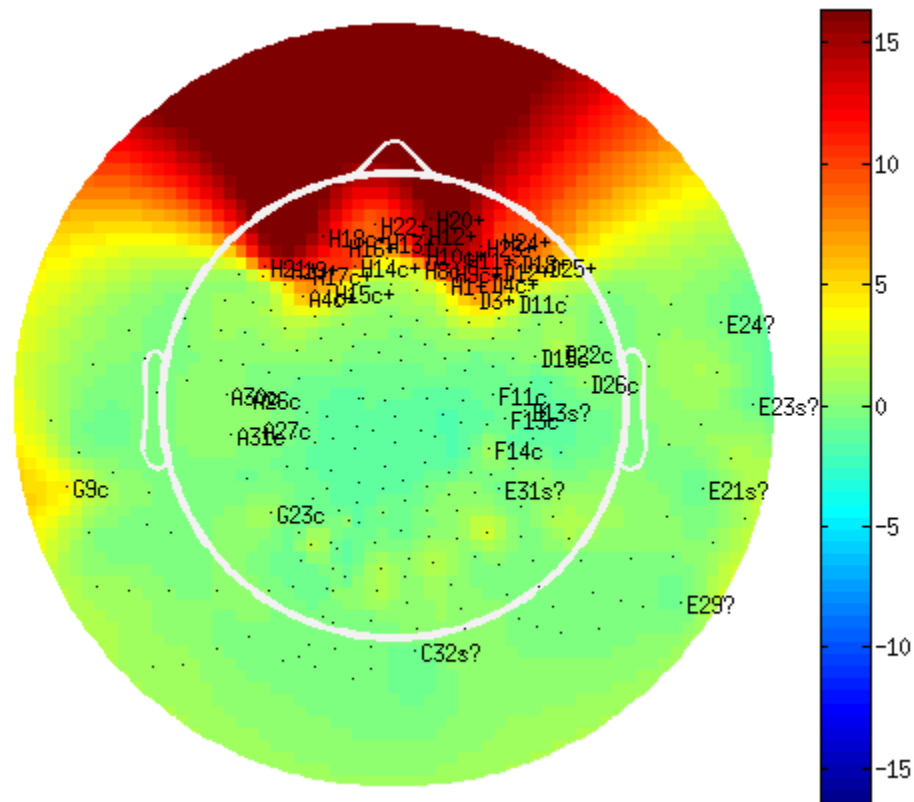




## Robust channel deviation (original)



## Robust channel deviation (marking interpolated)

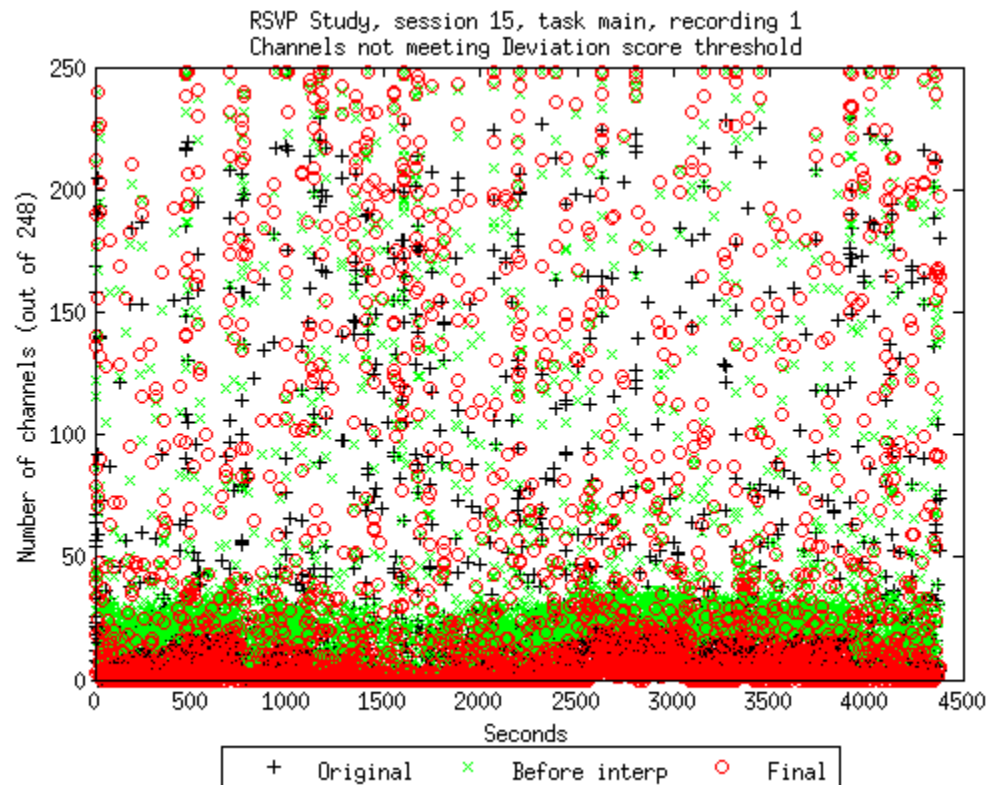
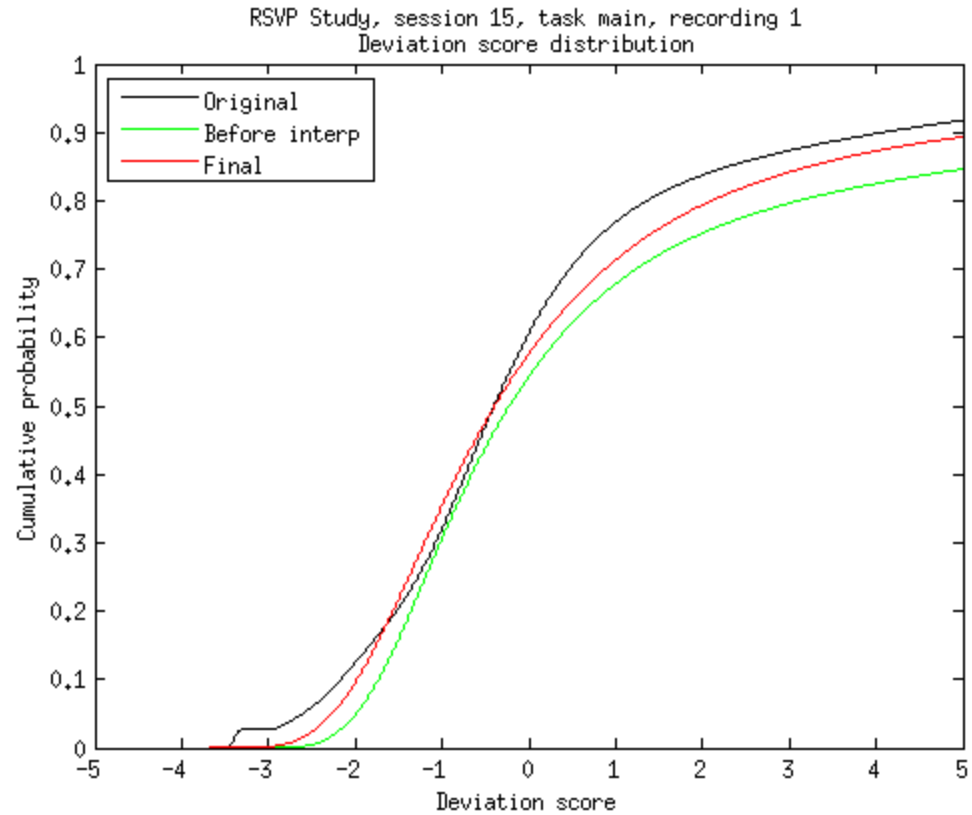


## Robust deviation window statistics

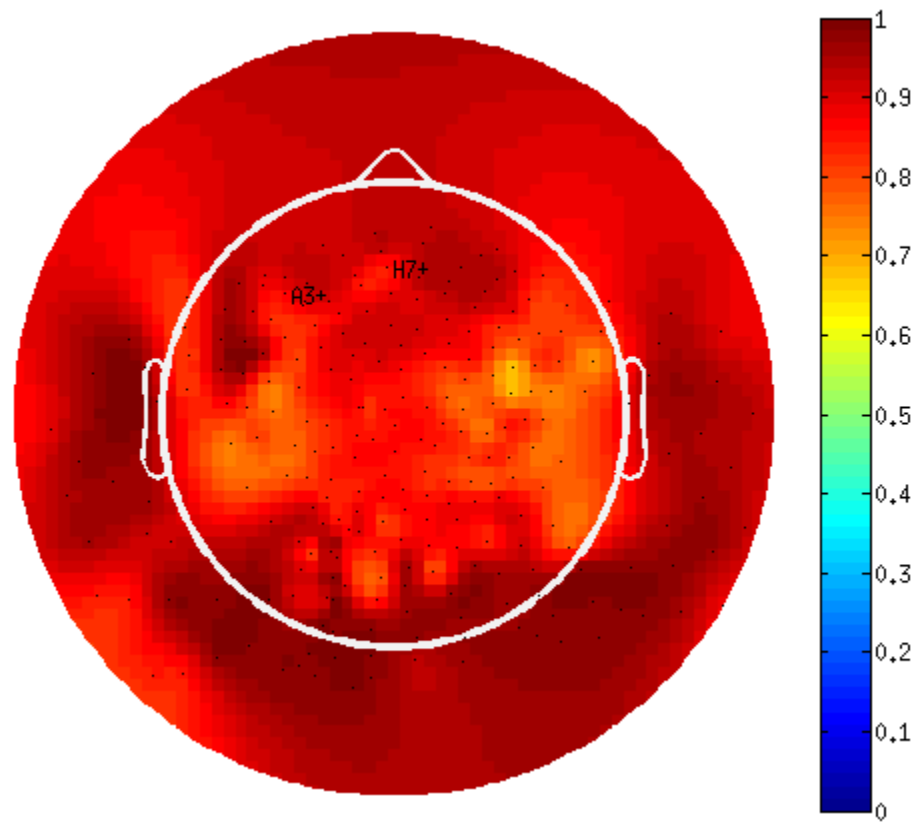
```
Deviation window statistics (over 4381 windows):  
Large deviation channel fraction:  
    [before=0.08265, after=0.1066]  
Median channel deviation: [before=9.1137, after=6.0753]  
SD channel deviation: [before=2.4512, after=1.1474]  
Max raw deviation level [before=187585.2365, after=65225.6177]  
Average fraction 0.08265 (20.4971 channels)  
    not meeting threshold before in each window  
Average fraction 0.1066 (26.4376 channels)  
    not meeting threshold after in each window  
Windows with > 1/4 deviation channels:  
    [before=364, after=581]  
Windows with > 1/2 deviation channels:  
    [before=212, after=392]  
Median window deviations: [before=8.1232, after=5.6231]  
SD window deviations: [before=3.6829, after=2.0475]  
Channels with dropouts: None
```

Visualize the EEG output from  
the PREP processing pipeline.

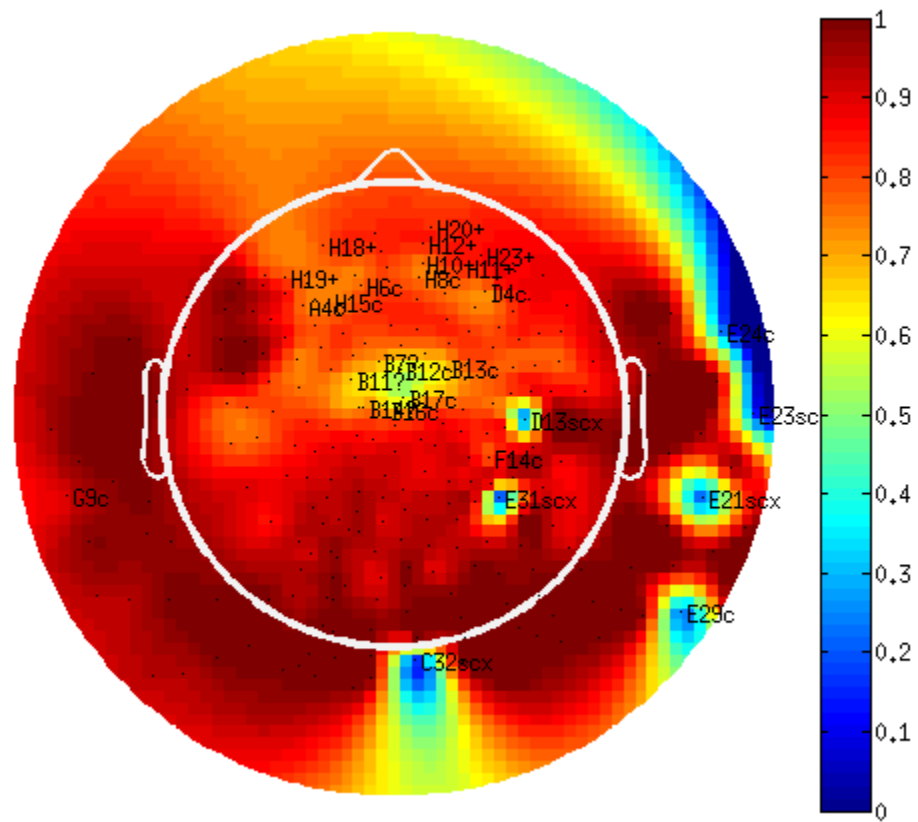
---



## Median max abs correlation (referenced)

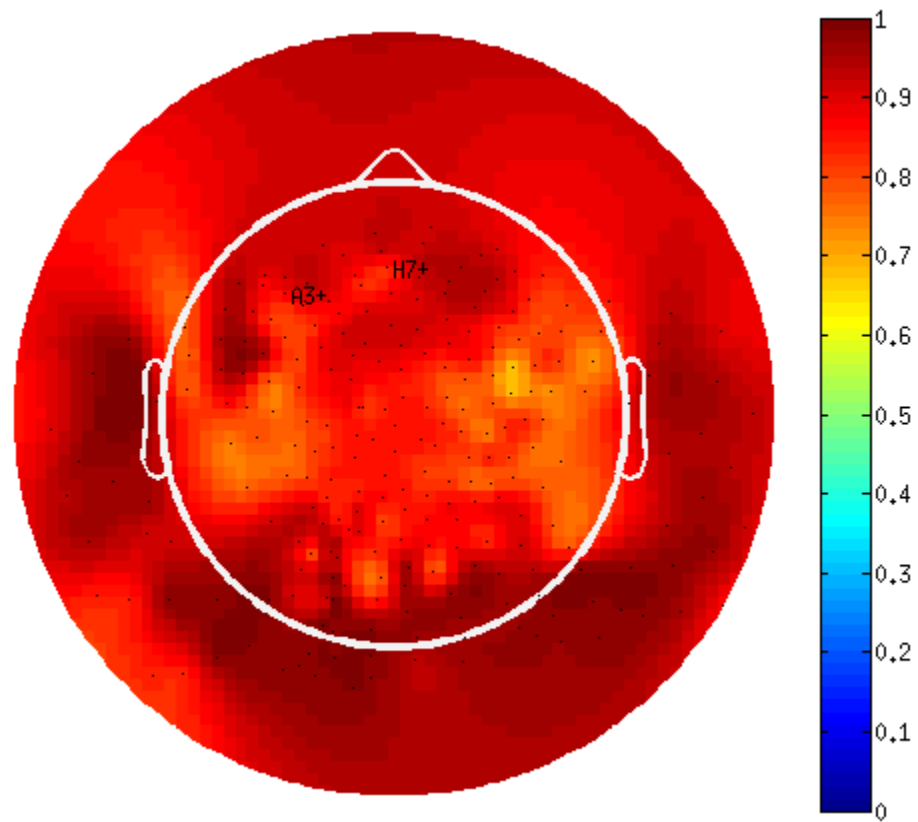


## Median max abs correlation (original)

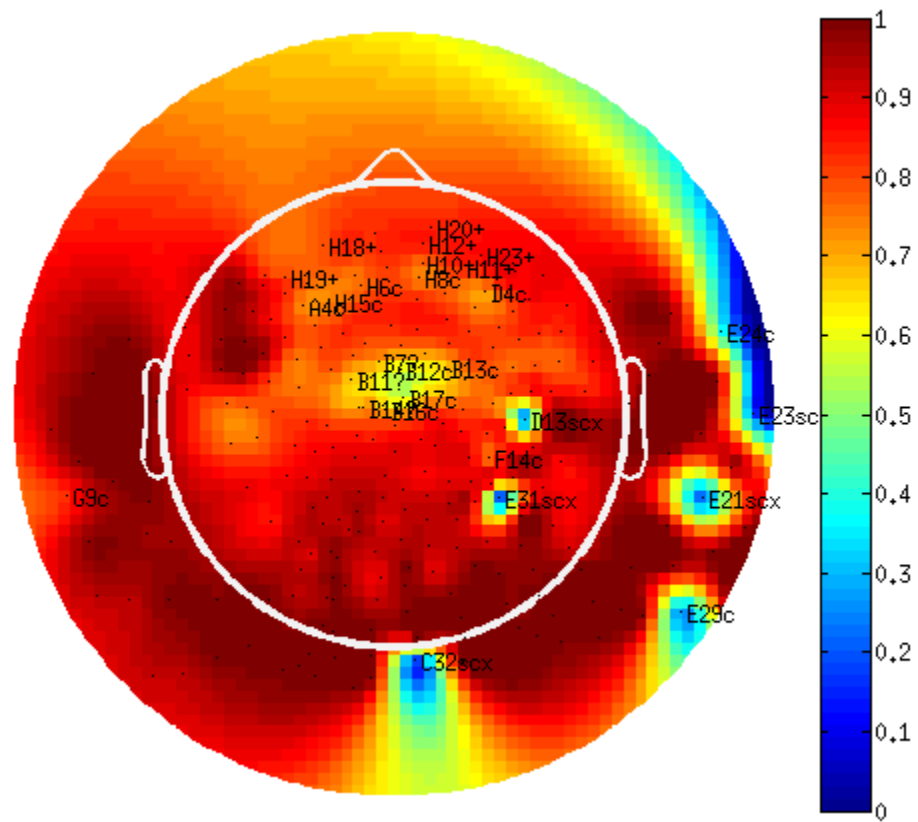




## Mean max abs correlation (referenced)



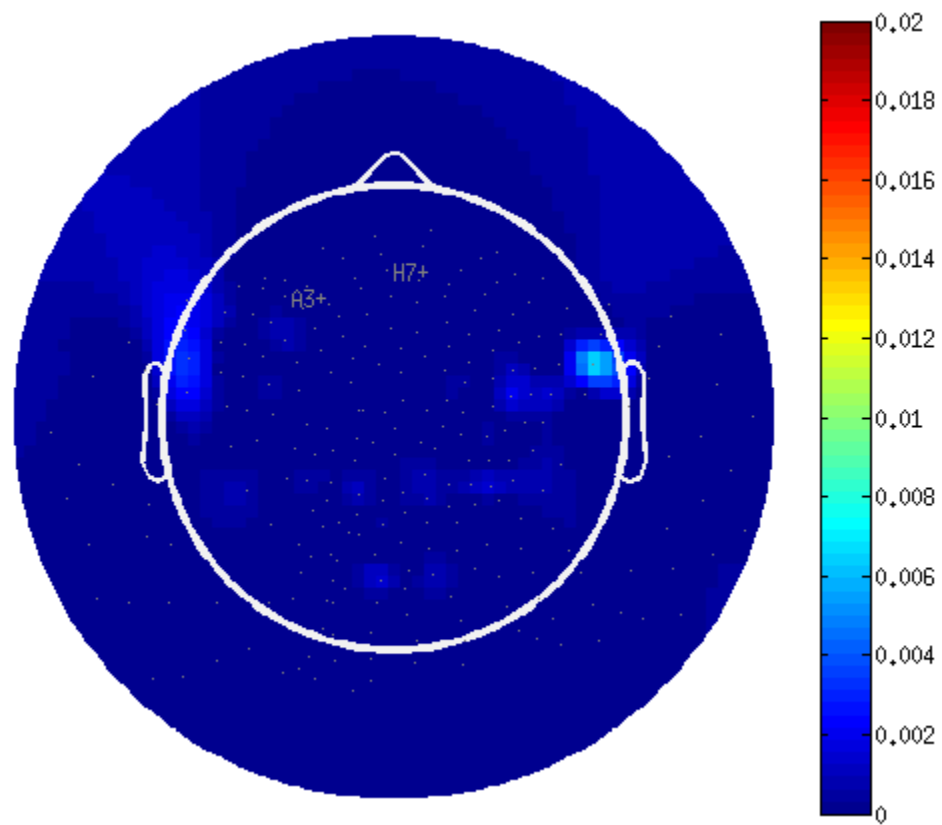
## Mean max abs correlation (original)





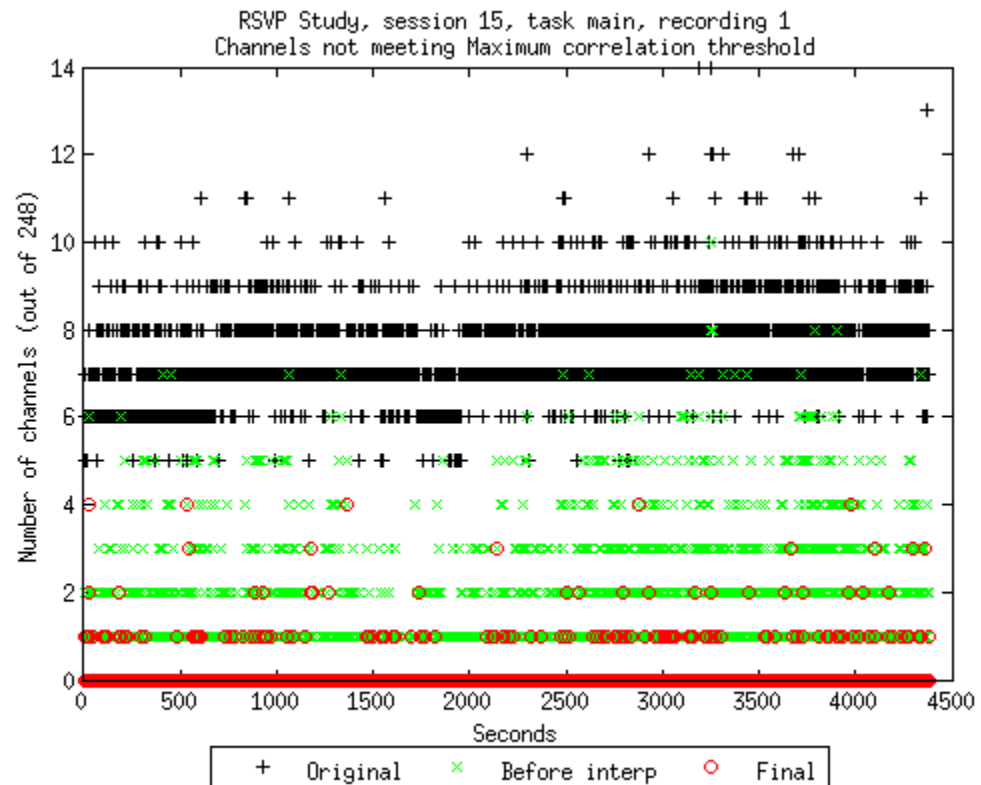
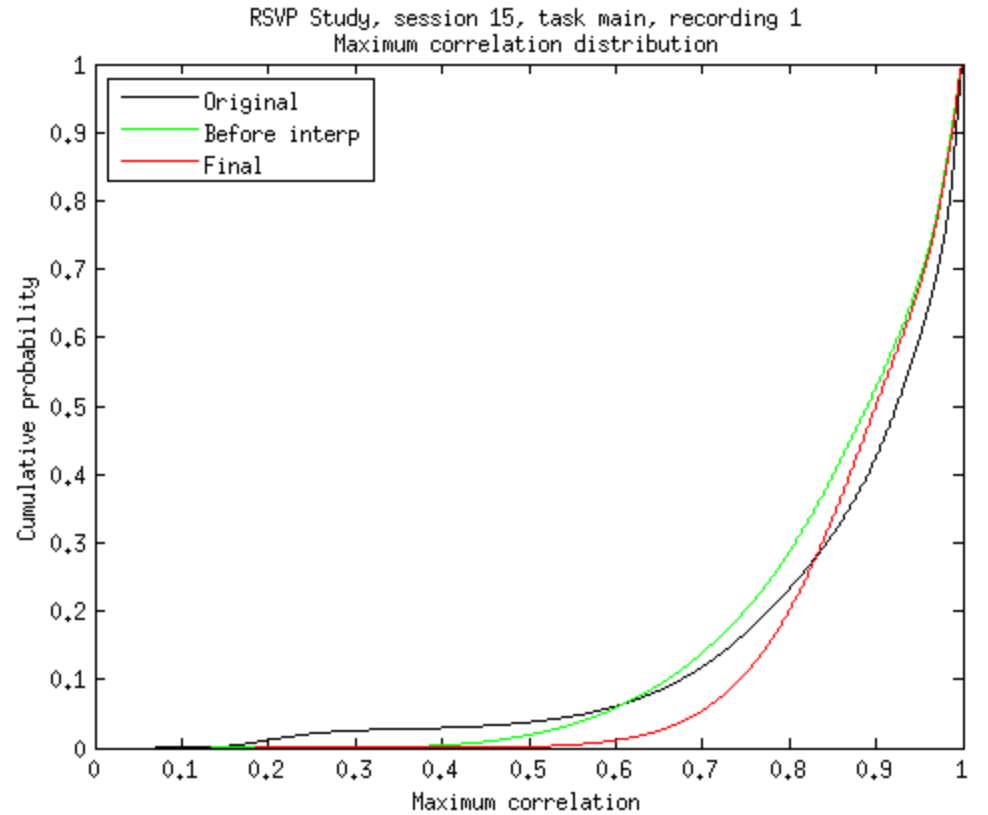


## Bad min max correlation fraction (referenced)

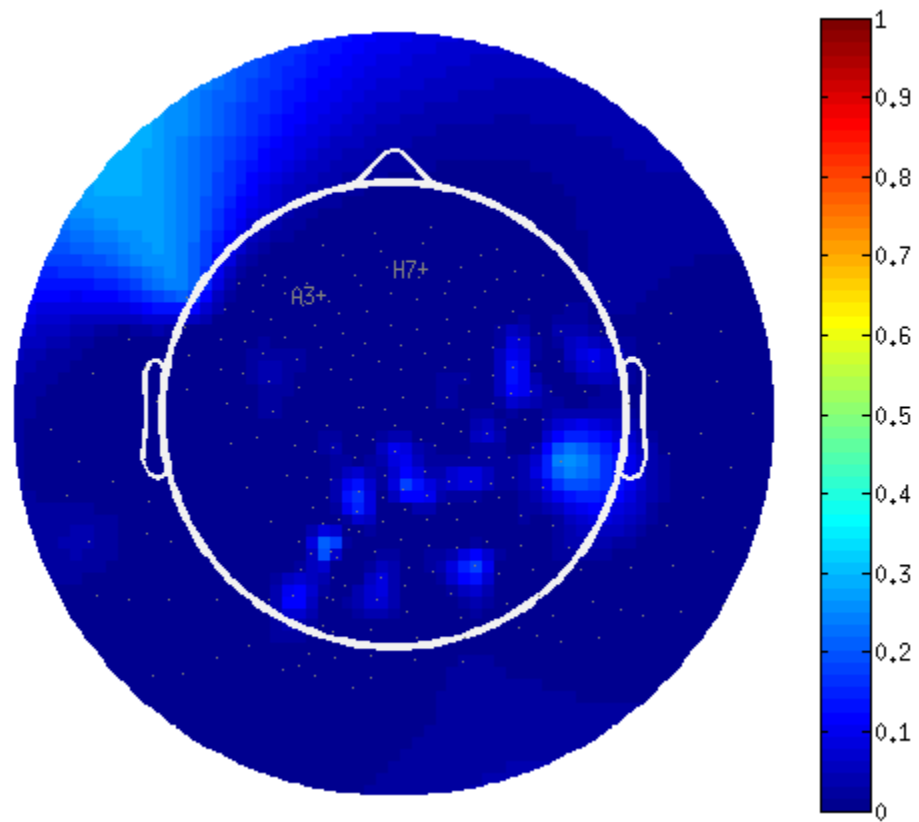




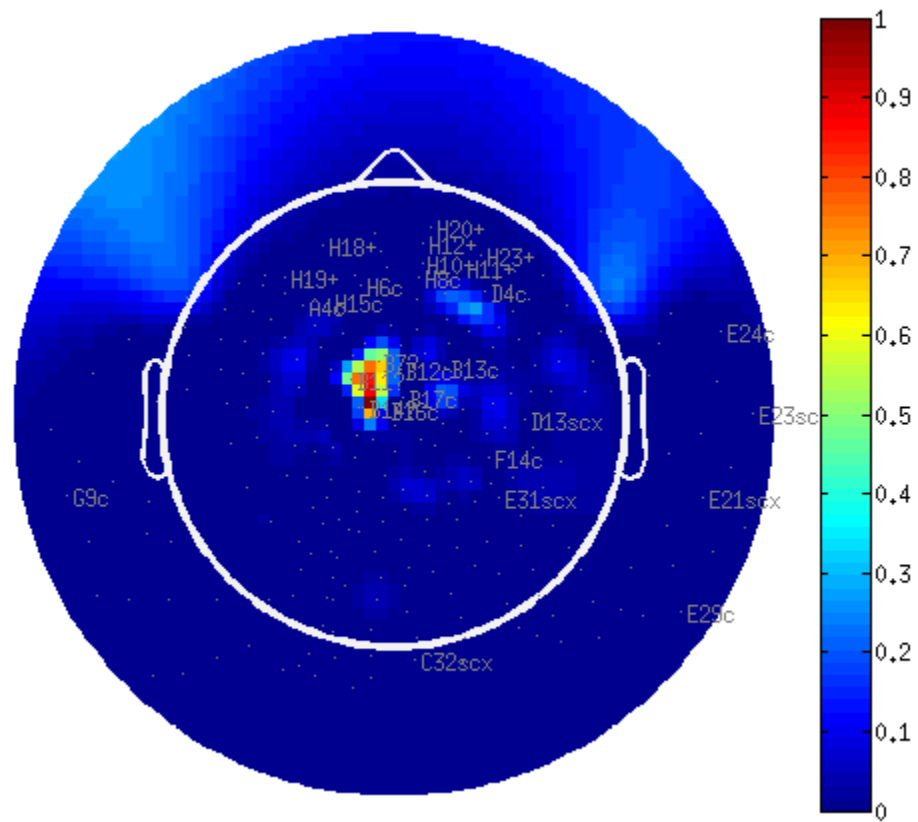




## Bad ransac fraction (referenced)

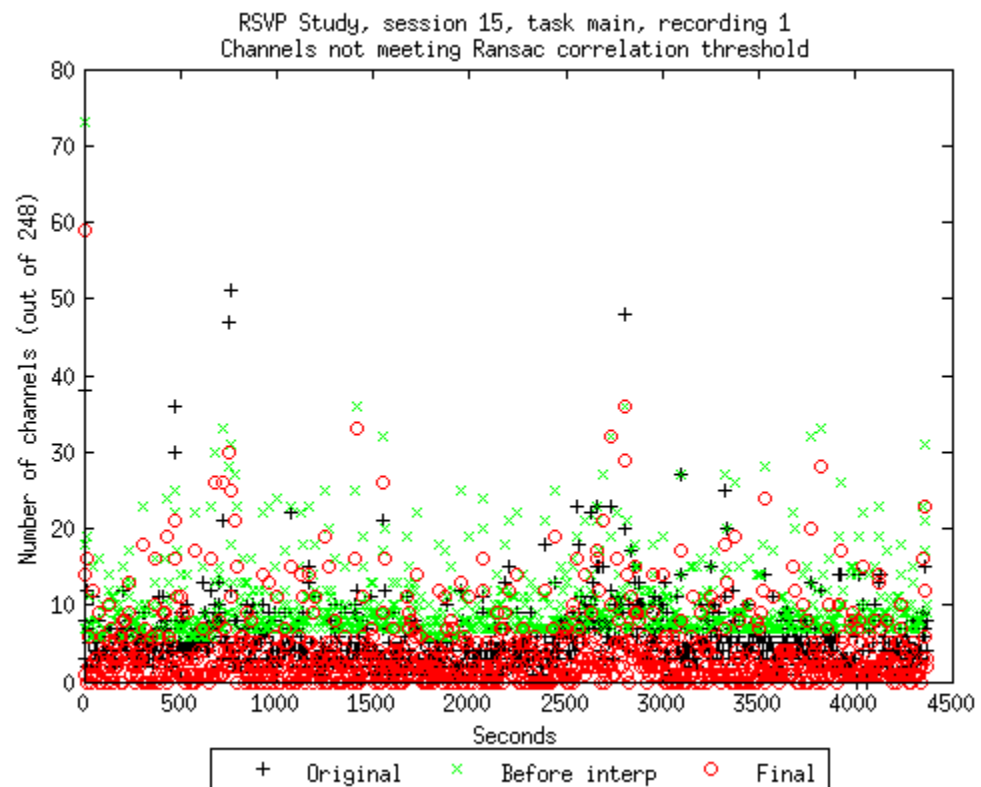
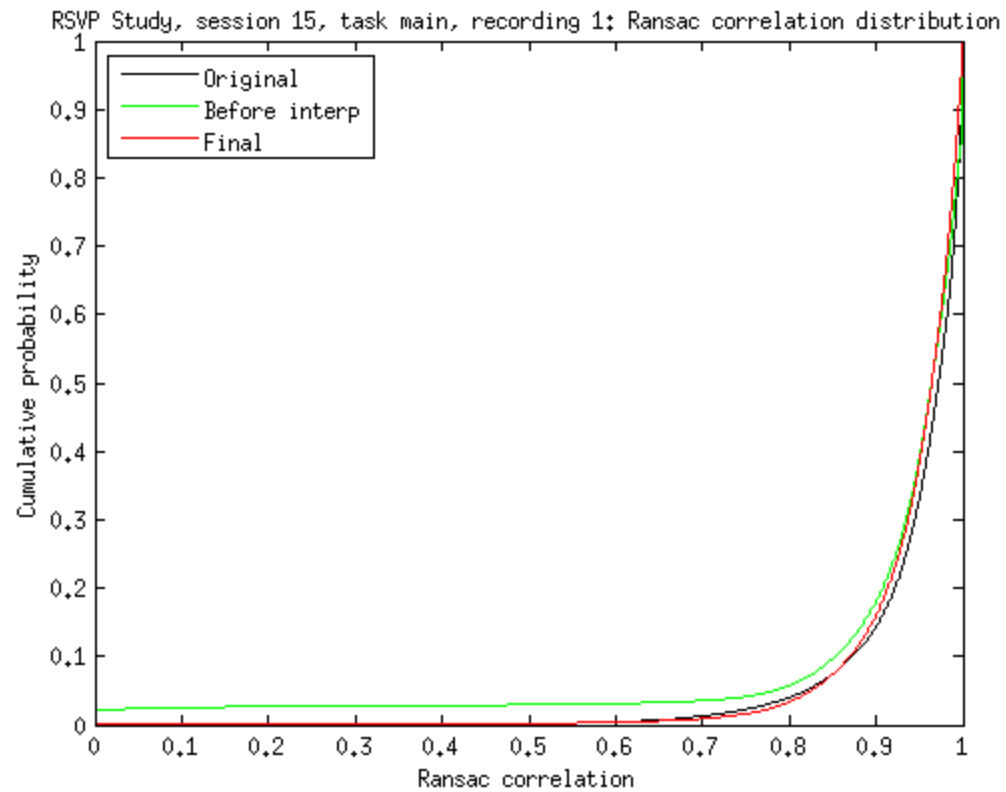


## Bad ransac fraction (original)

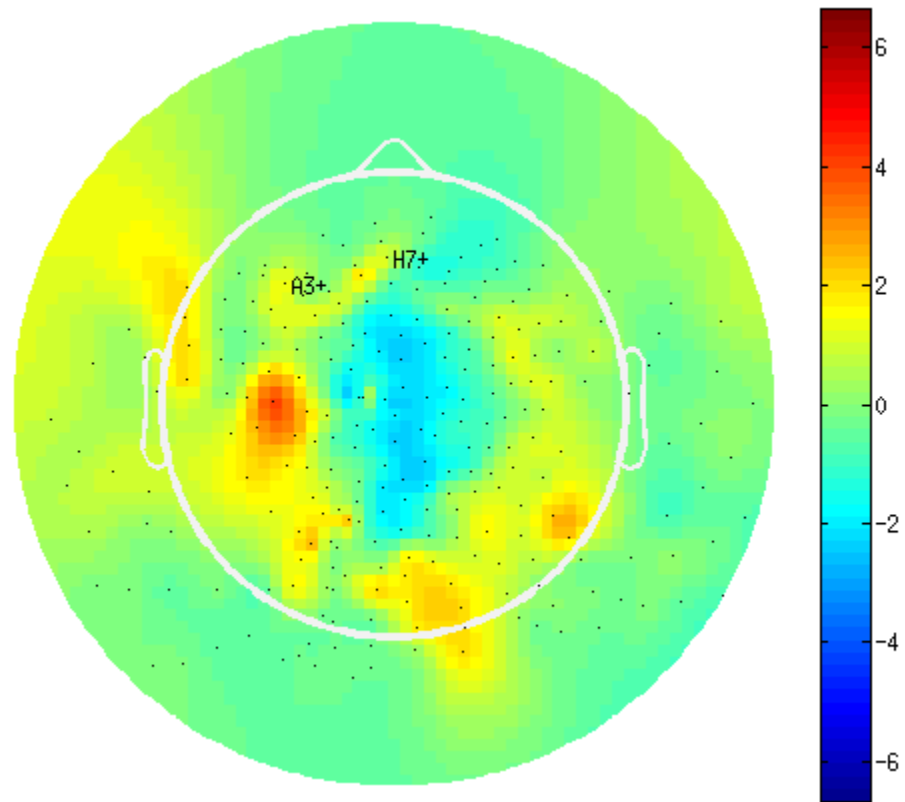






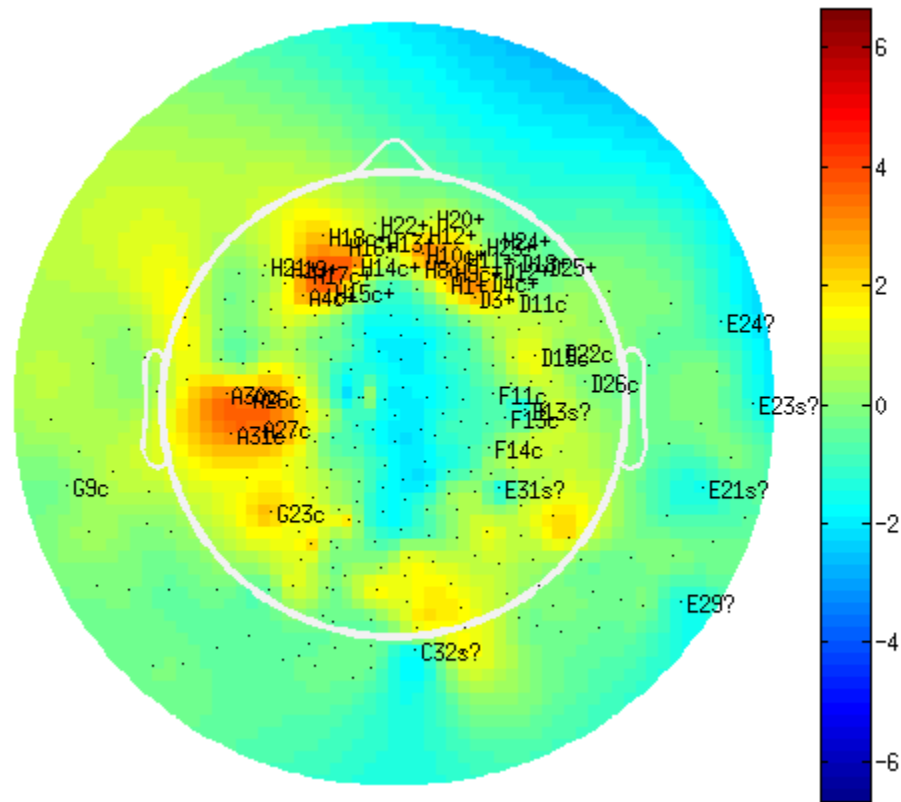


## HF noise Z-score (referenced)





## HF noise Z-score (marking interpolated)

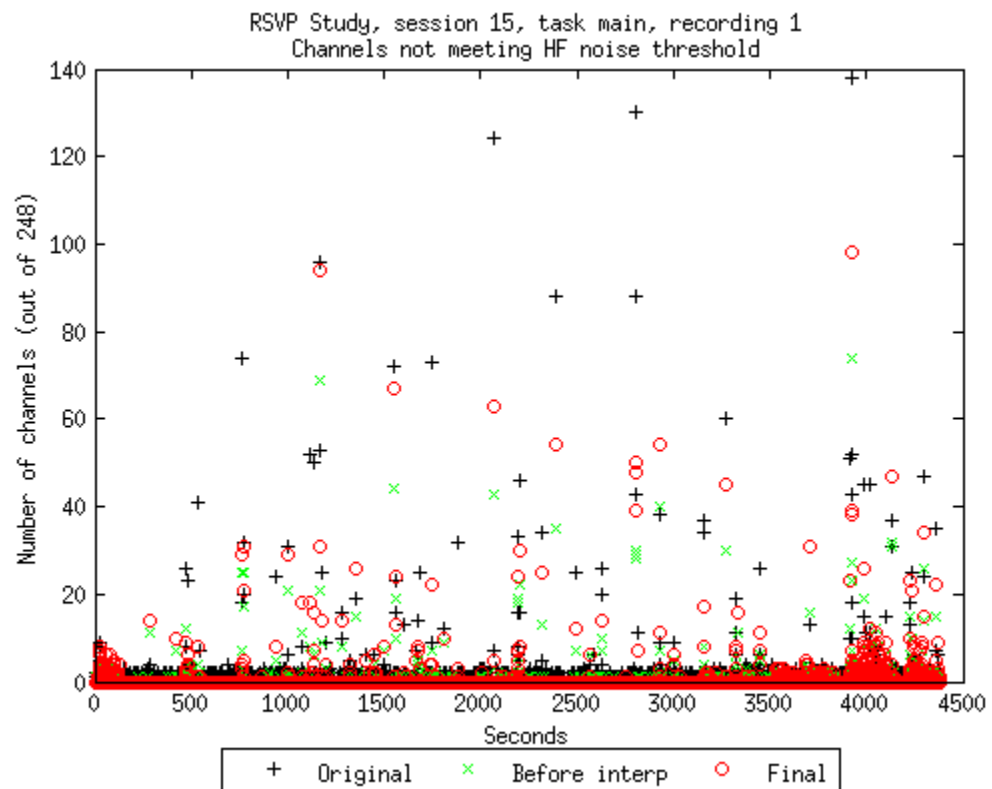
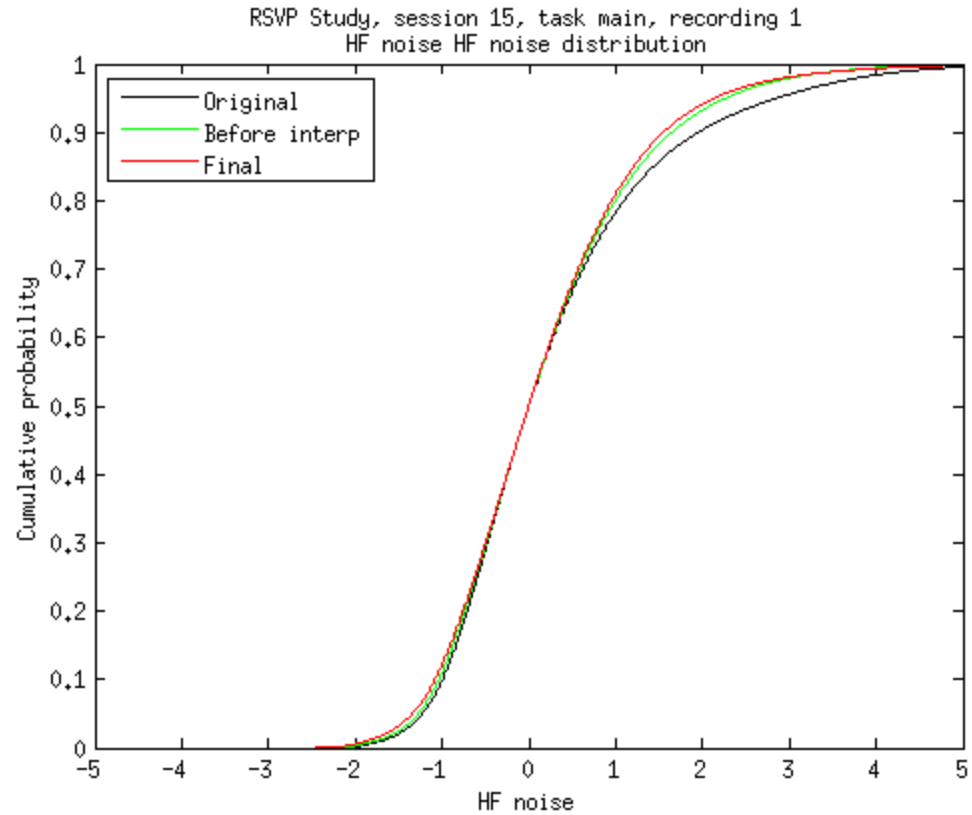


## HF noise window stats

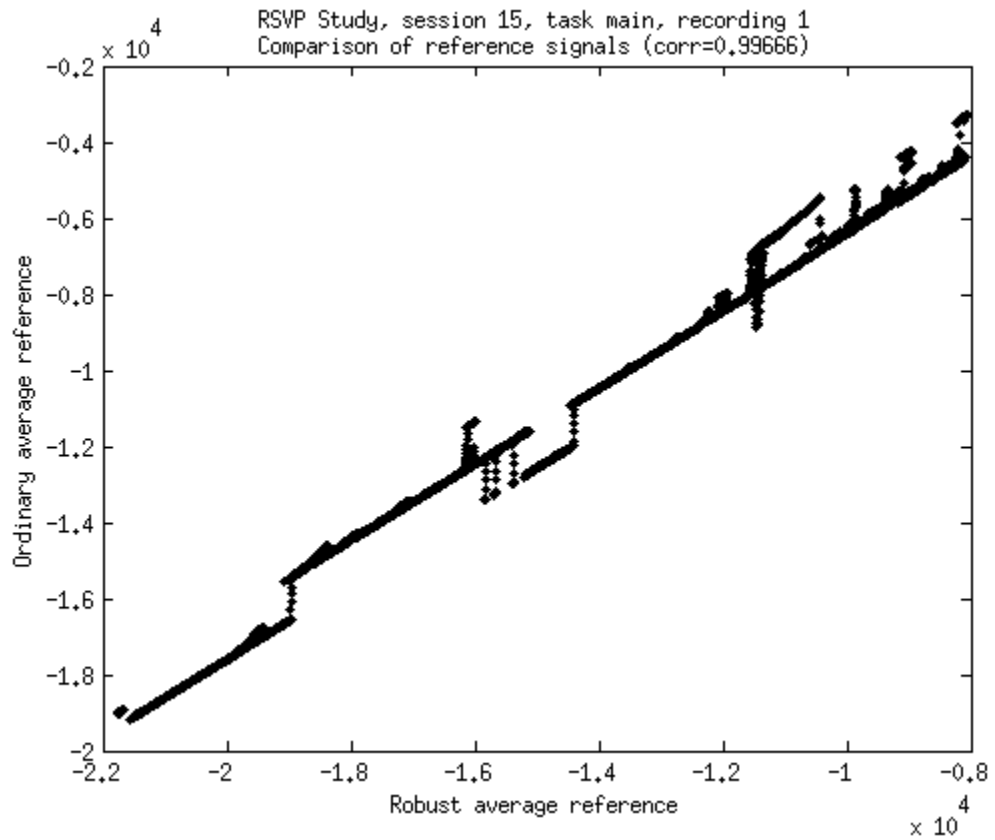
```
Noise window statistics (over 4381 windows):
Channel fraction with HF noise:
  [before=0.0045357, after=0.0023323]
Median noisiness: [before=0.47078, after=0.51235]
SD noisiness: [before=0.13063, after=0.082285]
Max HF noise levels [before=25.7348, after=3.0631]
Average fraction 0.0045357 (1.1249 channels):
  not meeting threshold before in each window
Average fraction 0.0023323 (0.57841 channels):
  not meeting threshold after in each window
  not meeting threshold after relative to before in each window
Windows with > 1/4 HF channels:
  [before=9, after=4]
Windows with > 1/2 HF channels:
  [before=2, after=0]
Median window HF: [before=0.51261, after=0.55695]
SD window HF: [before=0.21899, after=0.22755]
```

Visualize the EEG output from  
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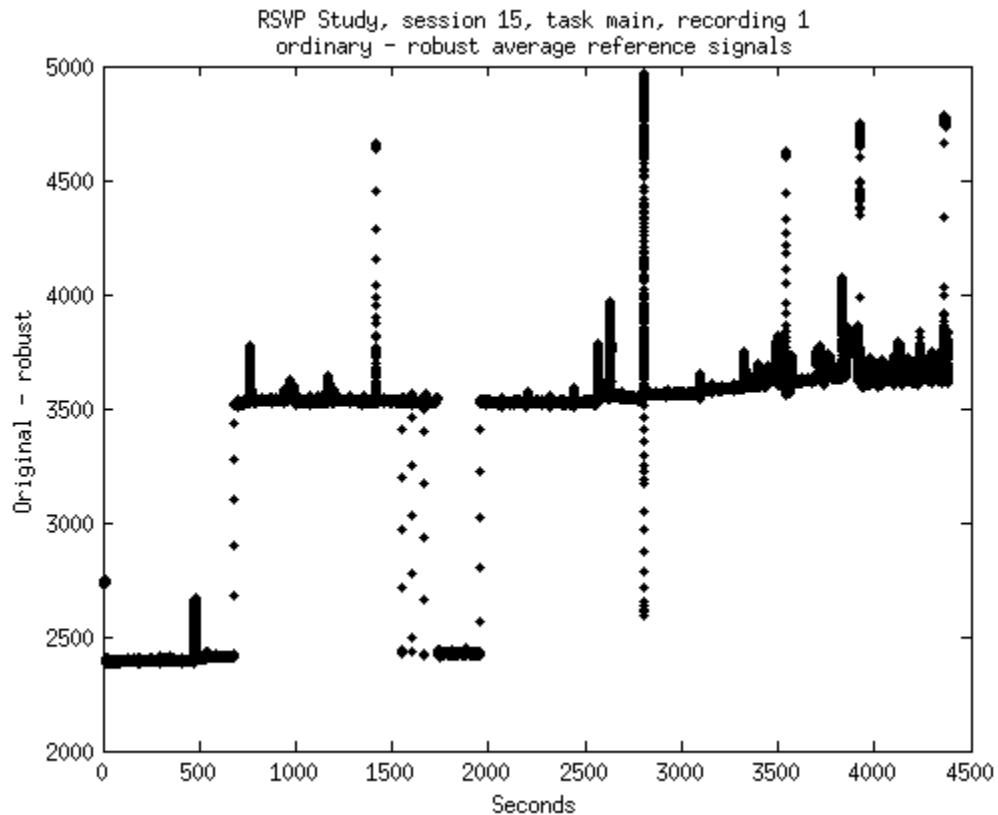
---



## Noisy average reference vs robust average reference



## Noisy average reference - robust average reference by time

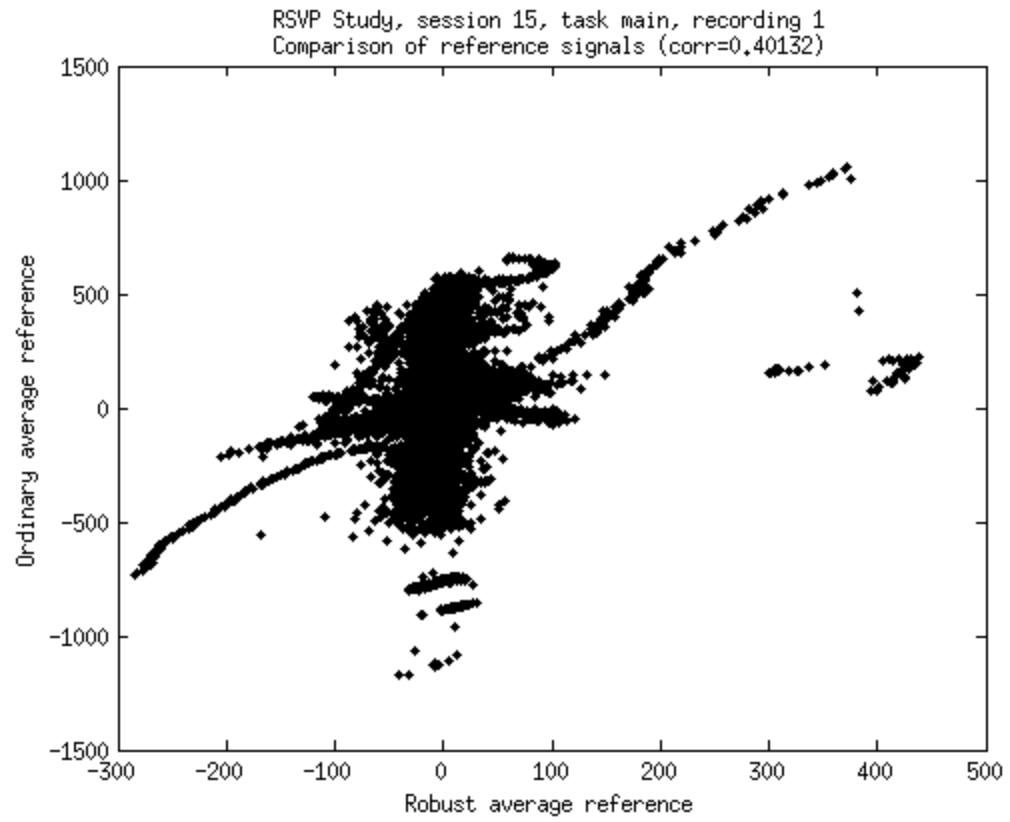


## Noisy average reference vs robust average reference (filtered)

```
pop_eegfiltnew() - performing 847 point highpass filtering.  
pop_eegfiltnew() - transition band width: 1 Hz  
pop_eegfiltnew() - passband edge(s): 1 Hz  
pop_eegfiltnew() - cutoff frequency(ies) (-6 dB): 0.5 Hz  
pop_eegfiltnew() - filtering the data  
firfilt(): |=====| 100%, ETE 00:00
```

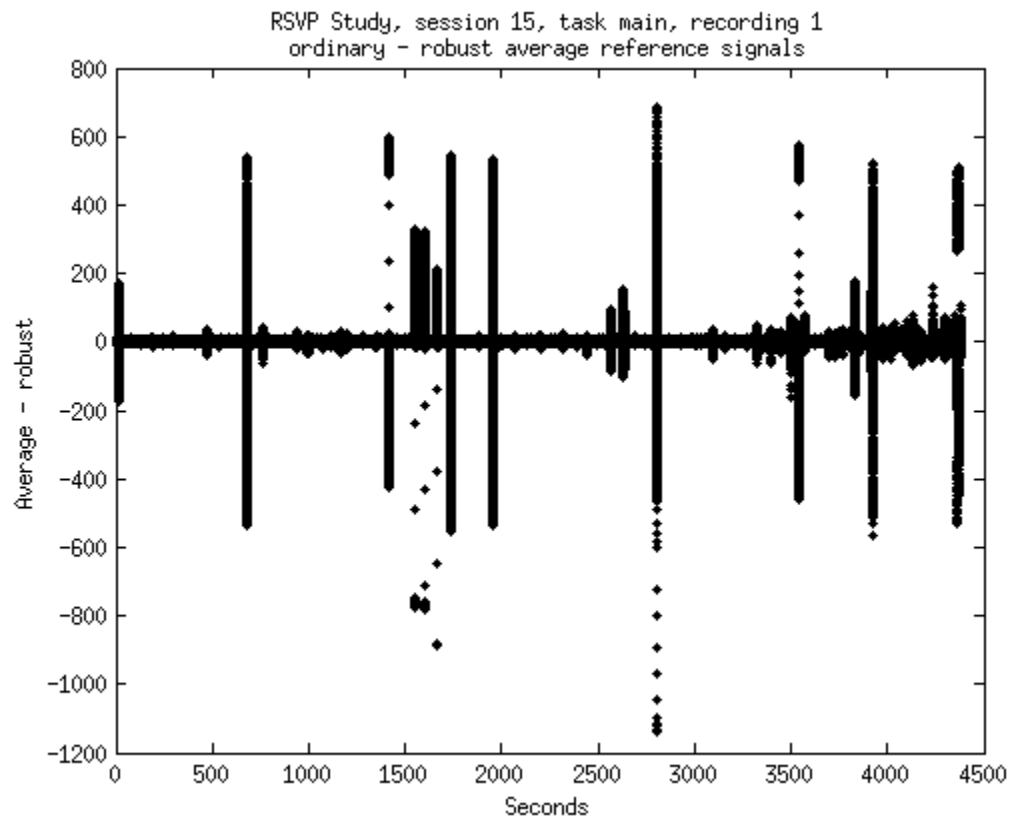
Visualize the EEG output from  
the PREP processing pipeline.

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## Noisy average reference - robust average reference by time



*Published with MATLAB® R2014a*