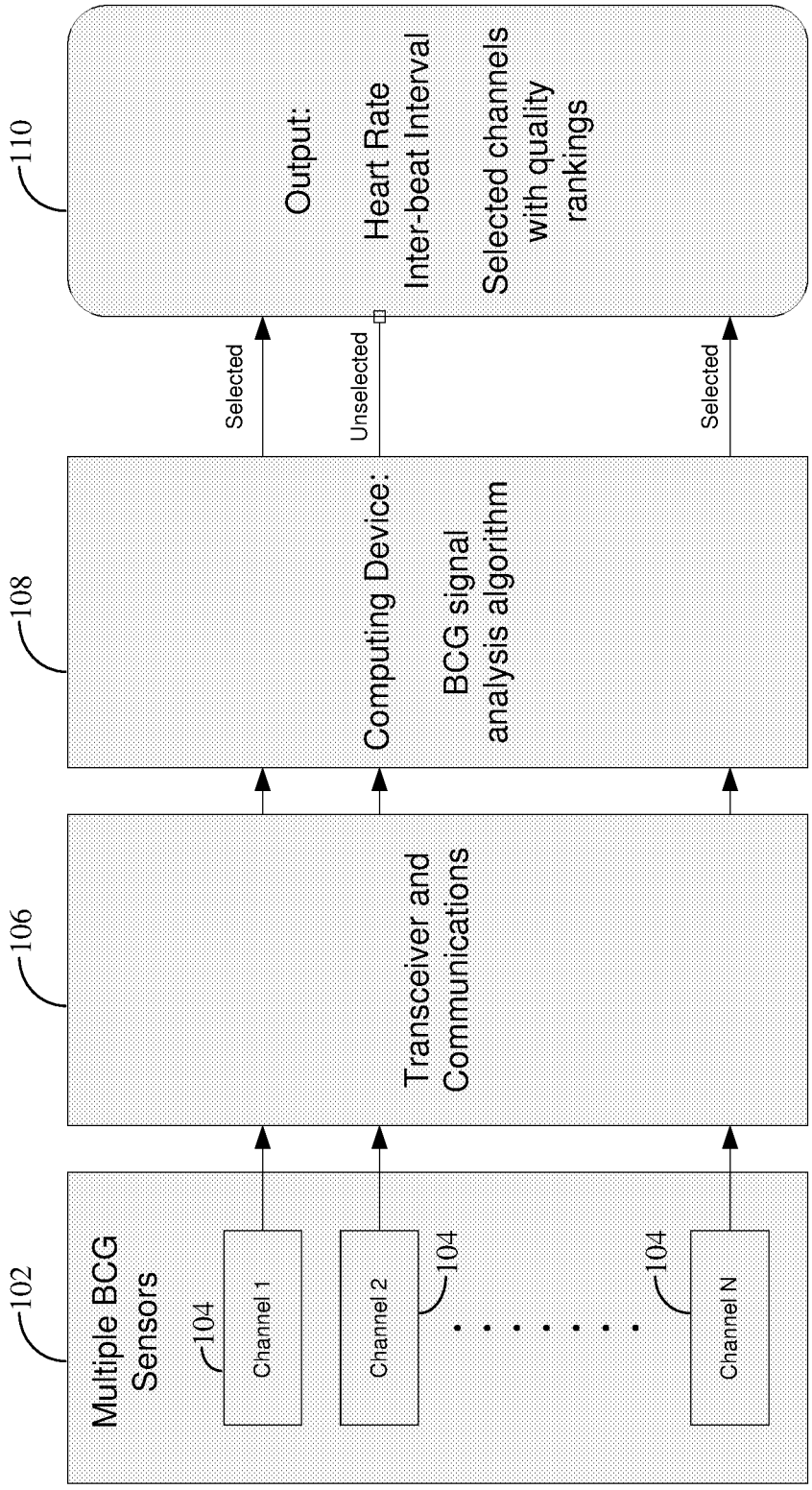

102
Multiple BCG Sensors
104
Channel 1
Channel 2
104
Channel N
104
106
Transceiver and Communications
108
Computing Device:
BCG signal analysis algorithm
Selected
Unselected
Selected
110
Output:
Heart Rate
Inter-beat Interval
Selected channels with quality rankings
100

FIG. 1

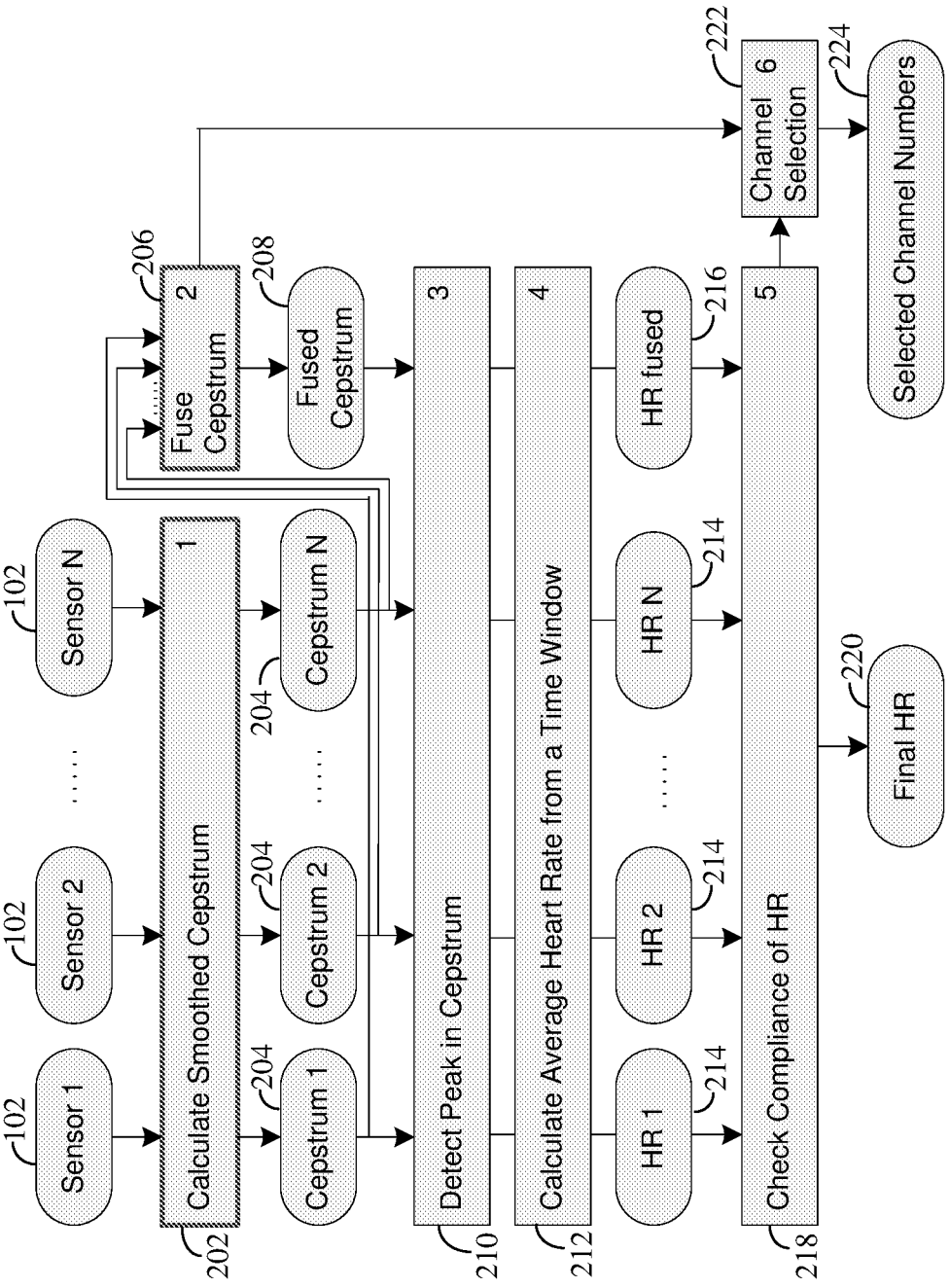

Sensor 1
Sensor 2
Sensor N
102
Calculate Smoothed Cepstrum
1
202
Cepstrum 1
Cepstrum 2
Cepstrum N
204
Fuse Cepstrum
2
206
Fused Cepstrum
208
Detect Peak in Cepstrum
3
210
Calculate Average Heart Rate from a Time Window
4
212
HR 1
HR 2
HR N
214
HR fused
216
Check Compliance of HR
5
218
Final HR
220
Channel Selection
6
222
Selected Channel Numbers
224
200

FIG. 2

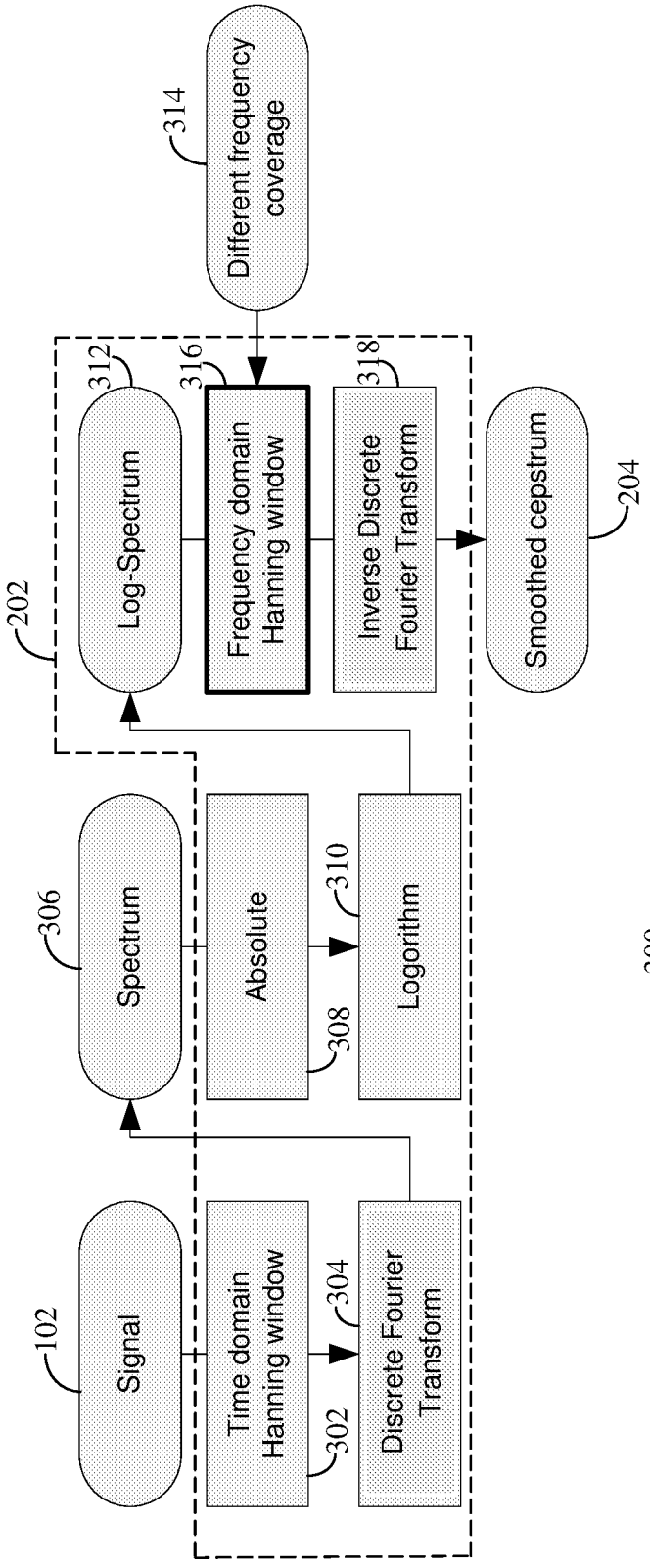

Different frequency coverage
314
Log-Spectrum
312
Frequency domain Hanning window
316
Inverse Discrete Fourier Transform
318
Smoothed cepstrum
204
202
Spectrum
306
Absolute
308
Logorithm
310
Signal
102
Time domain Hanning window
302
Discrete Fourier Transform
304
300

FIG. 3

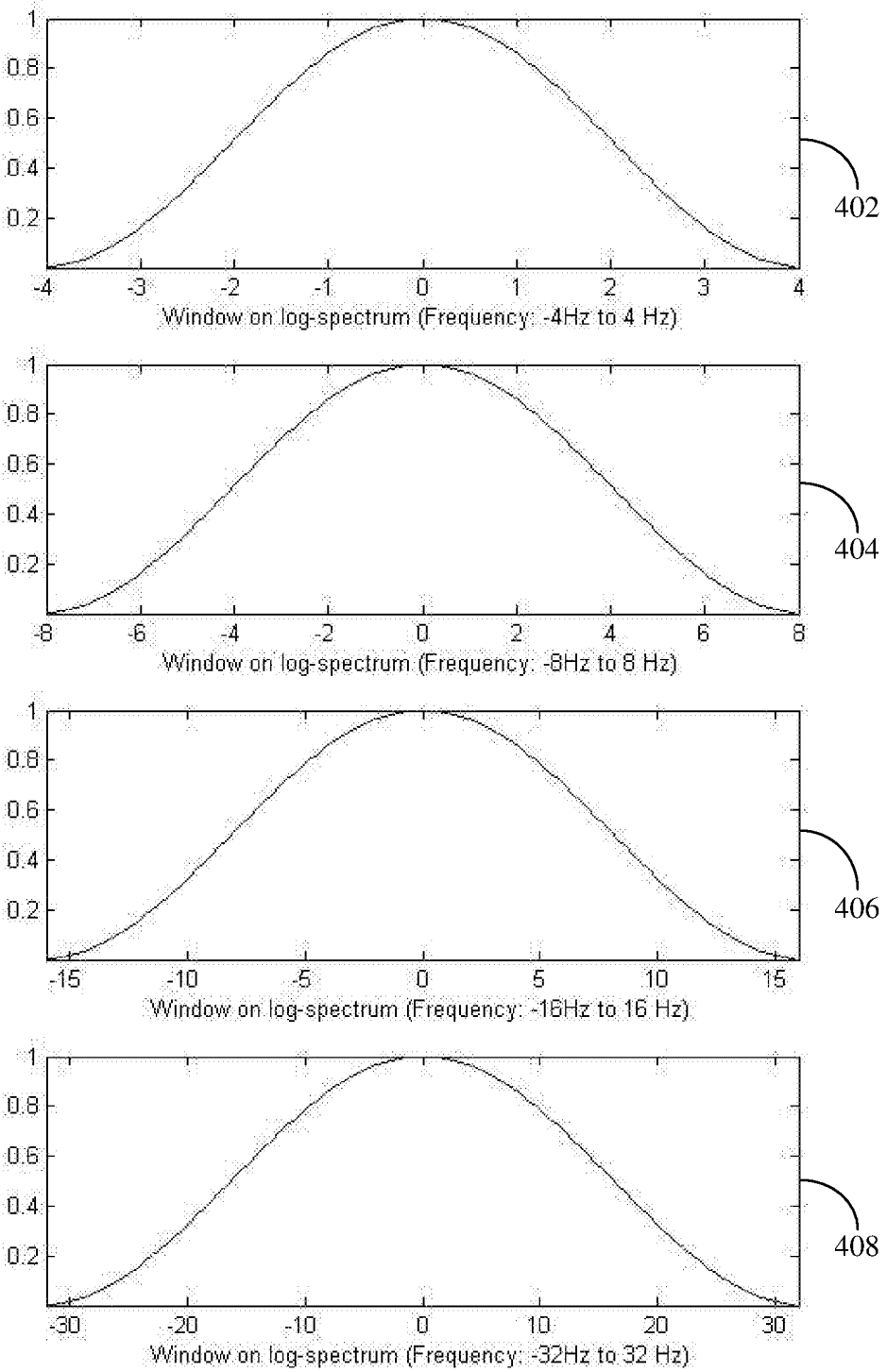

1
0.8
0.6
0.4
0.2
-4 -3 -2 -1 0 1 2 3 4
Window on log-spectrum (Frequency: -4Hz to 4 Hz)
402
-8 -6 -4 -2 0 2 4 6 8
Window on log-spectrum (Frequency: -8Hz to 8 Hz)
404
-15 -10 -5 0 5 10 15
Window on log-spectrum (Frequency: -16Hz to 16 Hz)
406
-30 -20 -10 0 10 20 30
Window on log-spectrum (Frequency: -32Hz to 32 Hz)
408

FIG. 4

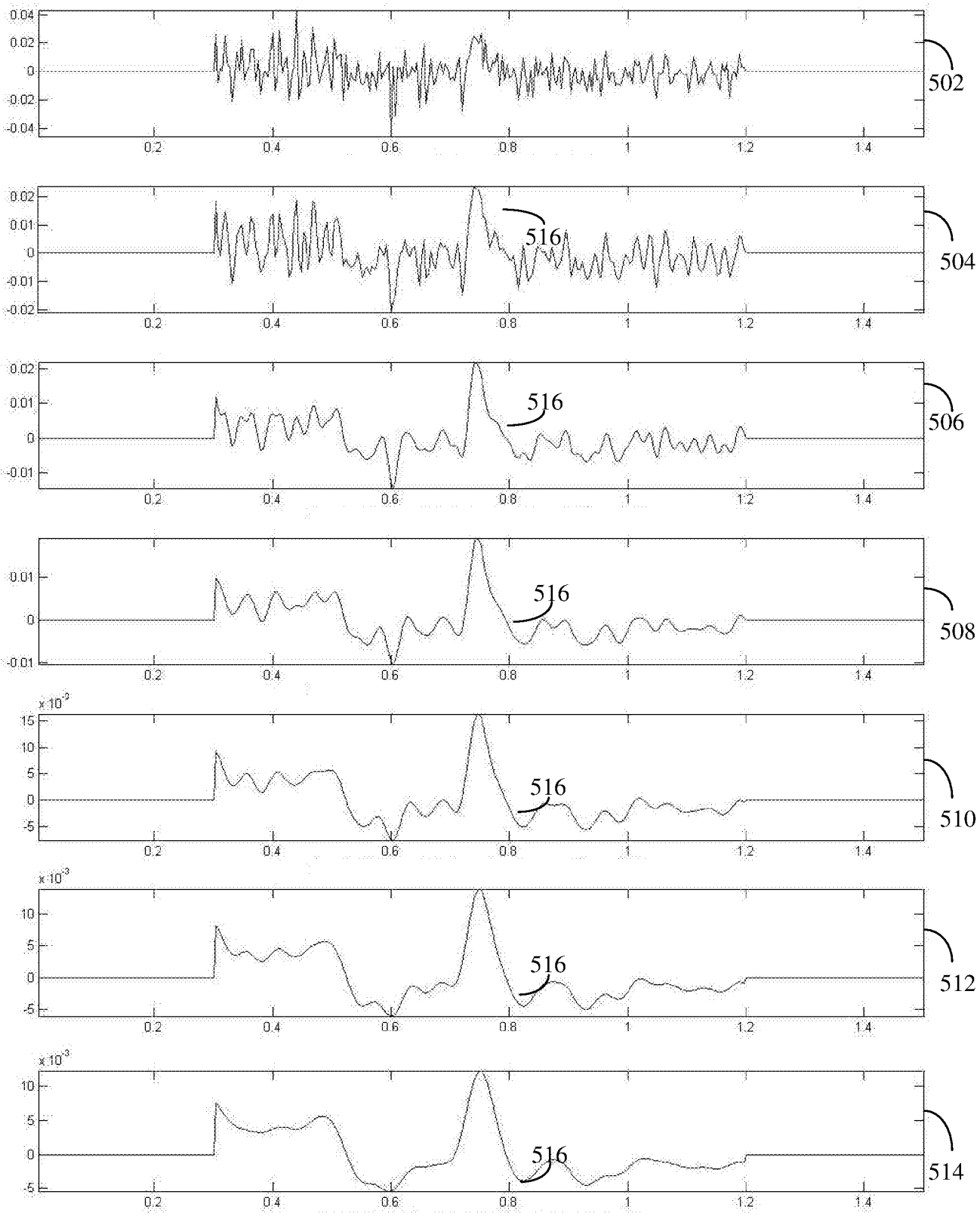
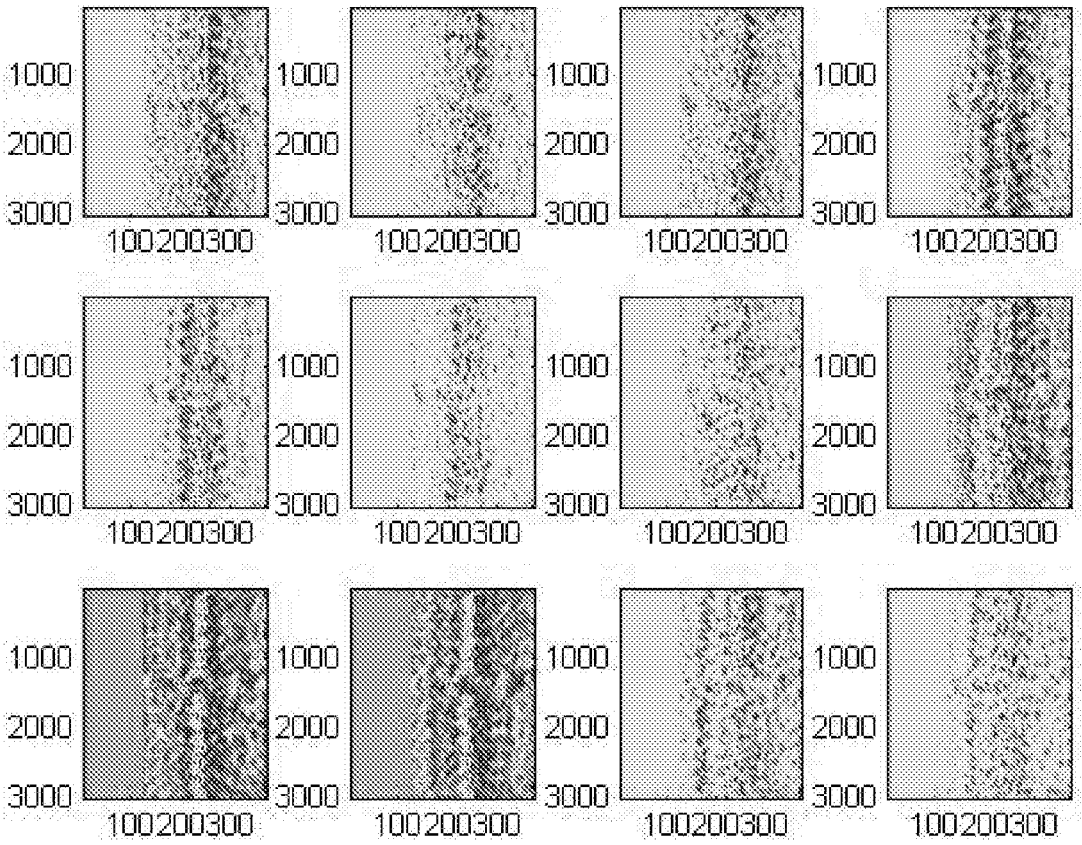
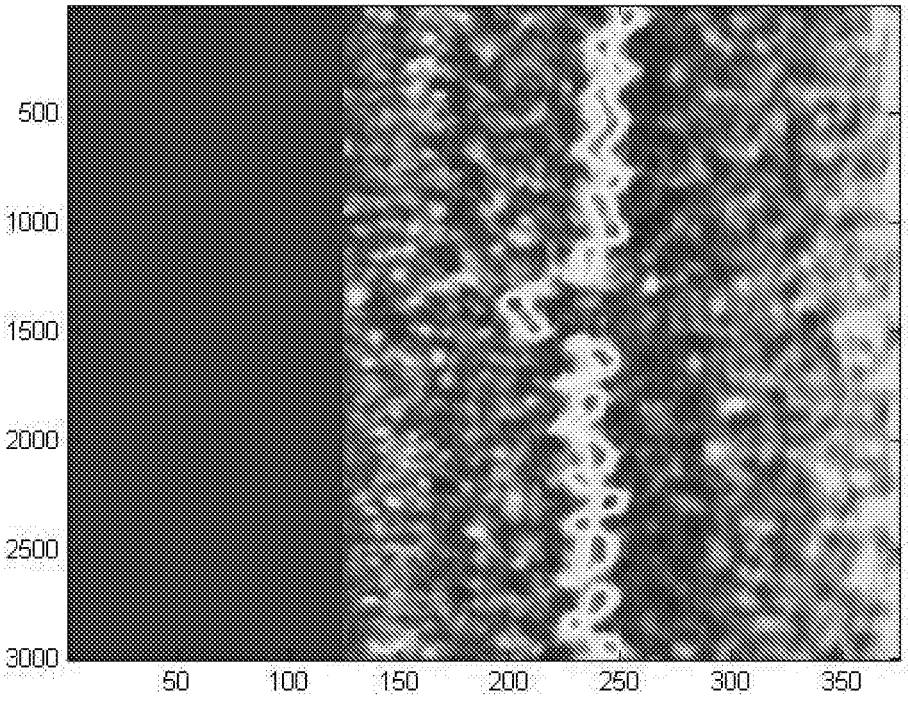


FIG. 5



600

FIG. 6



700

FIG. 7

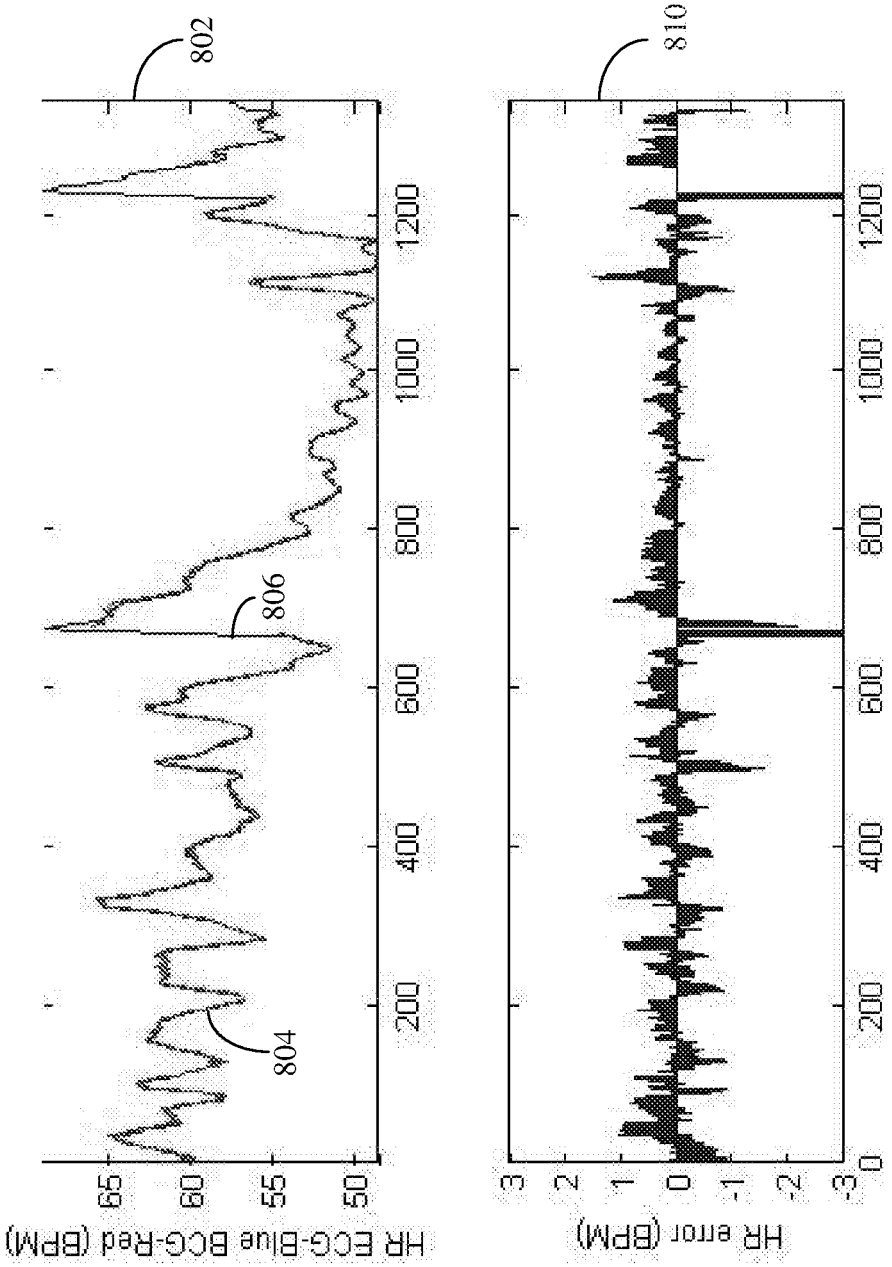

802
806
804
810
HR ECG-Blue BCG-Red (BPM)
HR error (BPM)
65
60
55
50
200
400
600
800
1000
1200
3
2
1
0
-1
-2
-3

FIG. 8

Subject	1	2	3	4	5	6	7	8	9	10	11	12
HR Error Mean	0.49	0.35	0.33	0.30	0.18	0.35	0.50	0.45	0.36	0.23	0.33	0.27
HR Error Standard Deviation	0.51	0.52	0.56	0.32	0.27	0.34	0.46	0.54	0.43	0.42	0.39	0.37

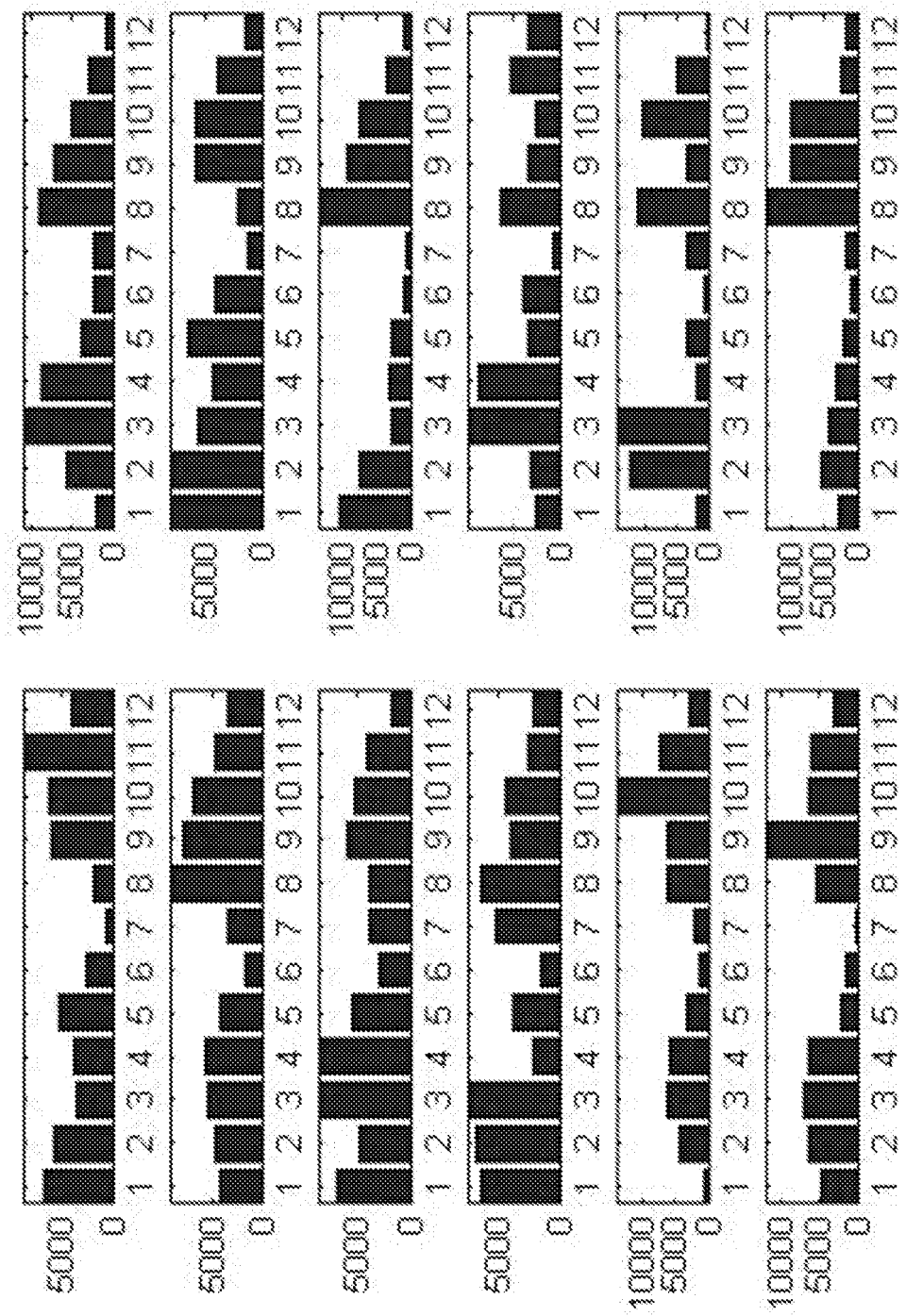
900

FIG. 9

Subject	1	2	3	4	5	6	7	8	9	10	11	12
Acceptance Rate	0.93	0.95	0.94	0.90	0.97	0.95	0.85	0.88	0.96	0.99	0.95	0.93

1000

FIG. 10



1100

FIG. 11