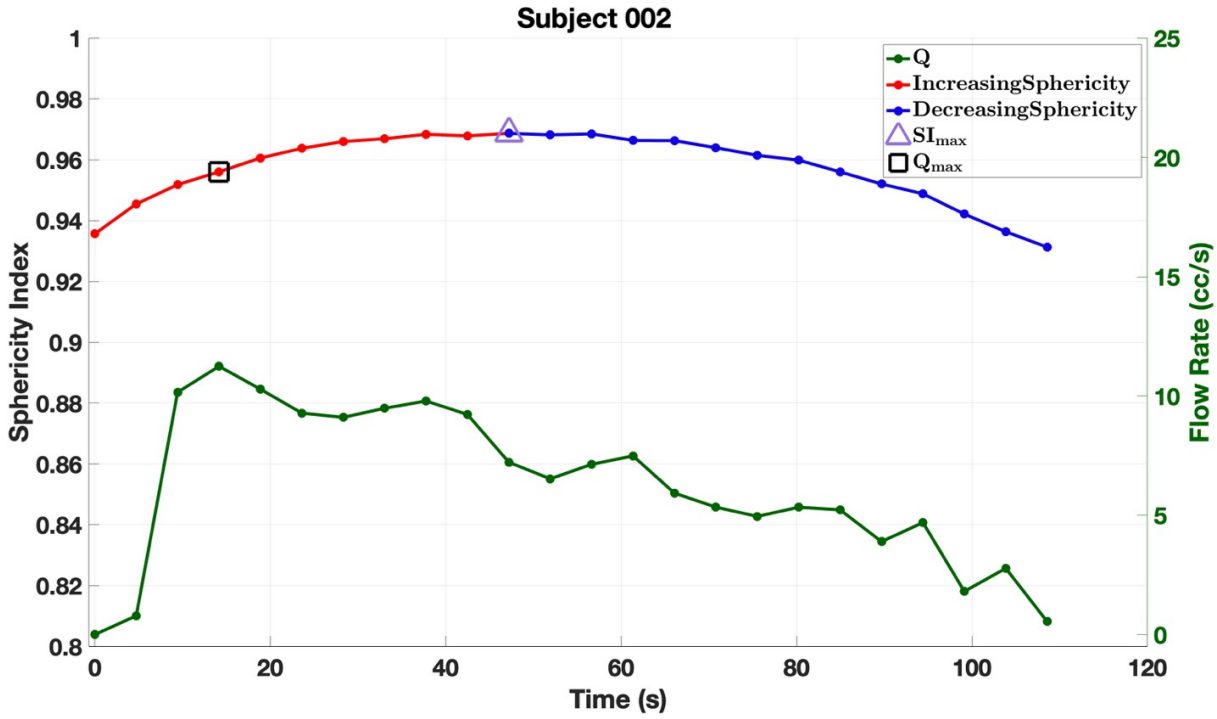
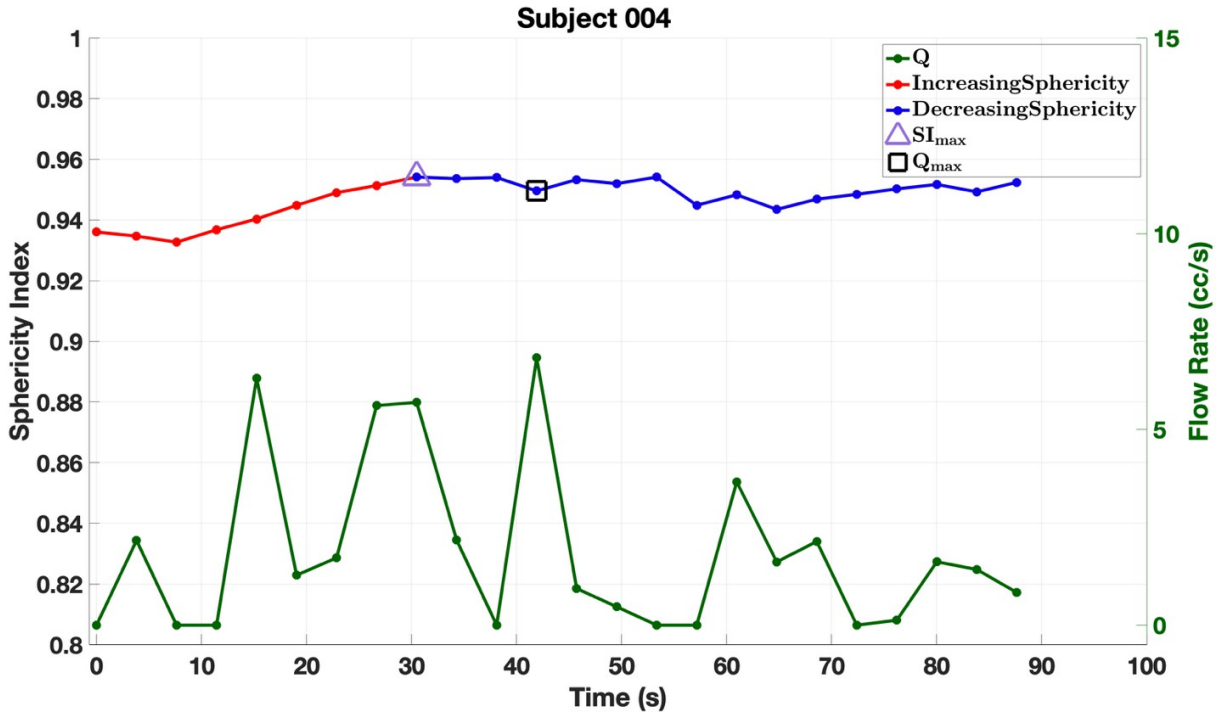
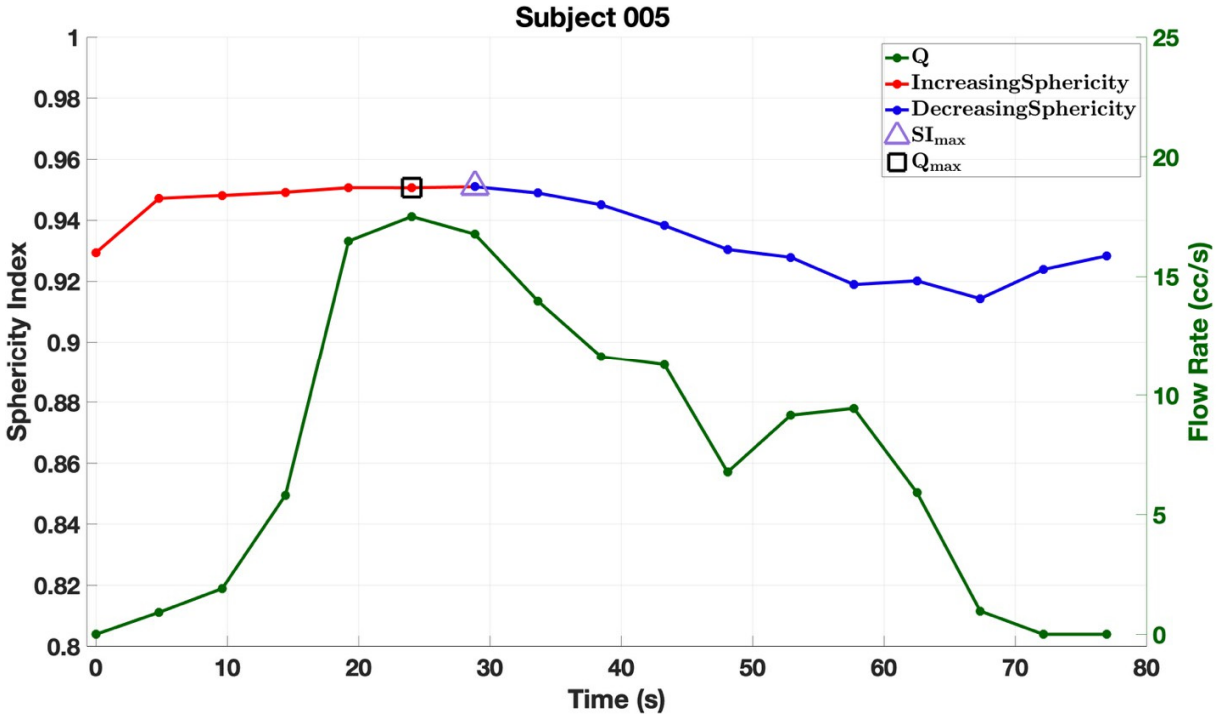
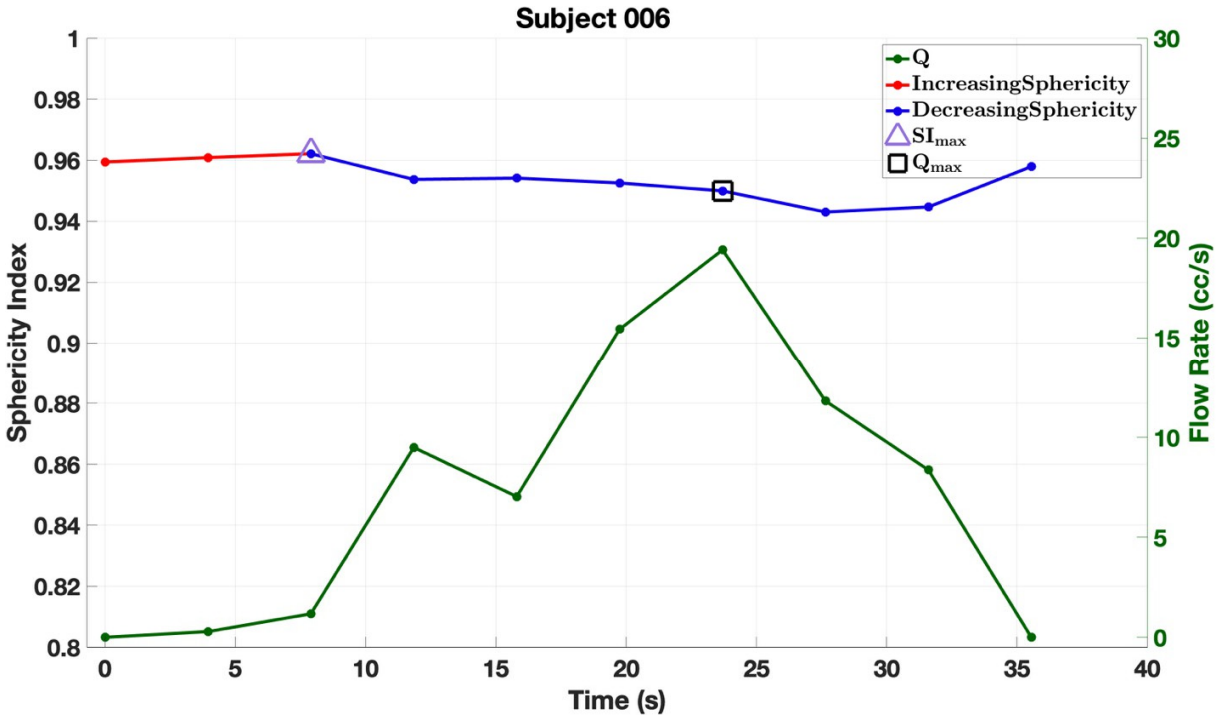
Supplemental Document

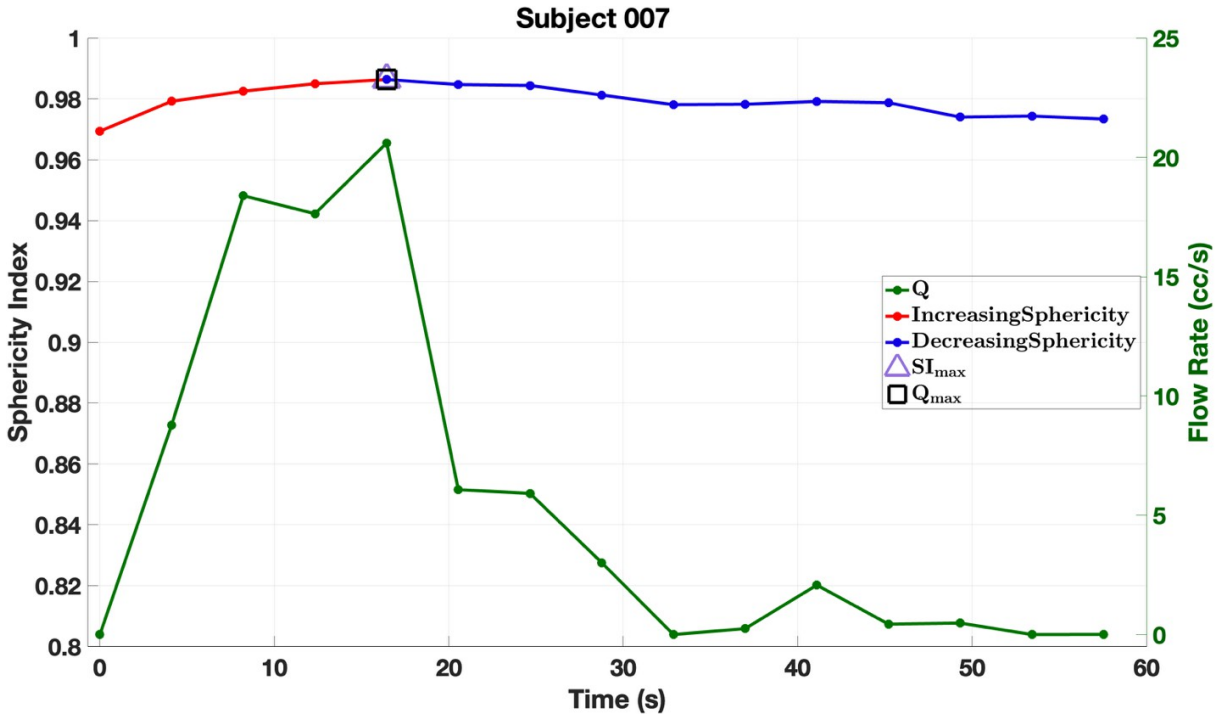
Supplementary Materials S1: Flow Rate and Sphericity Index Curves

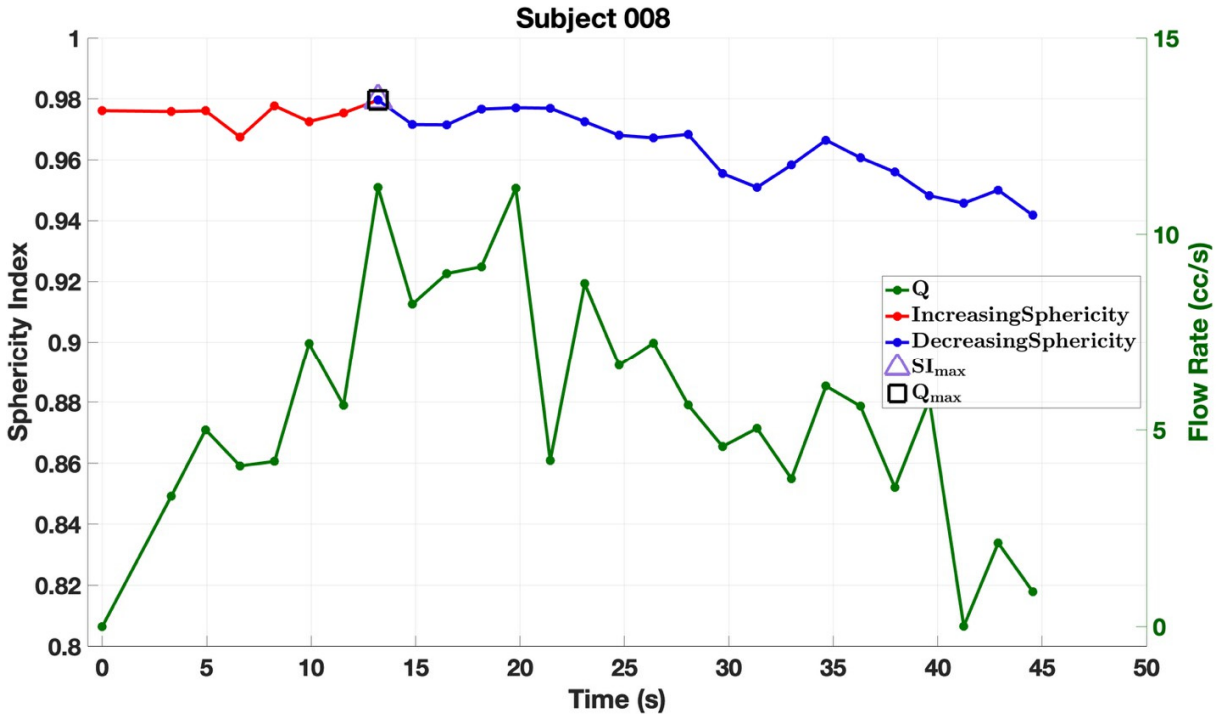


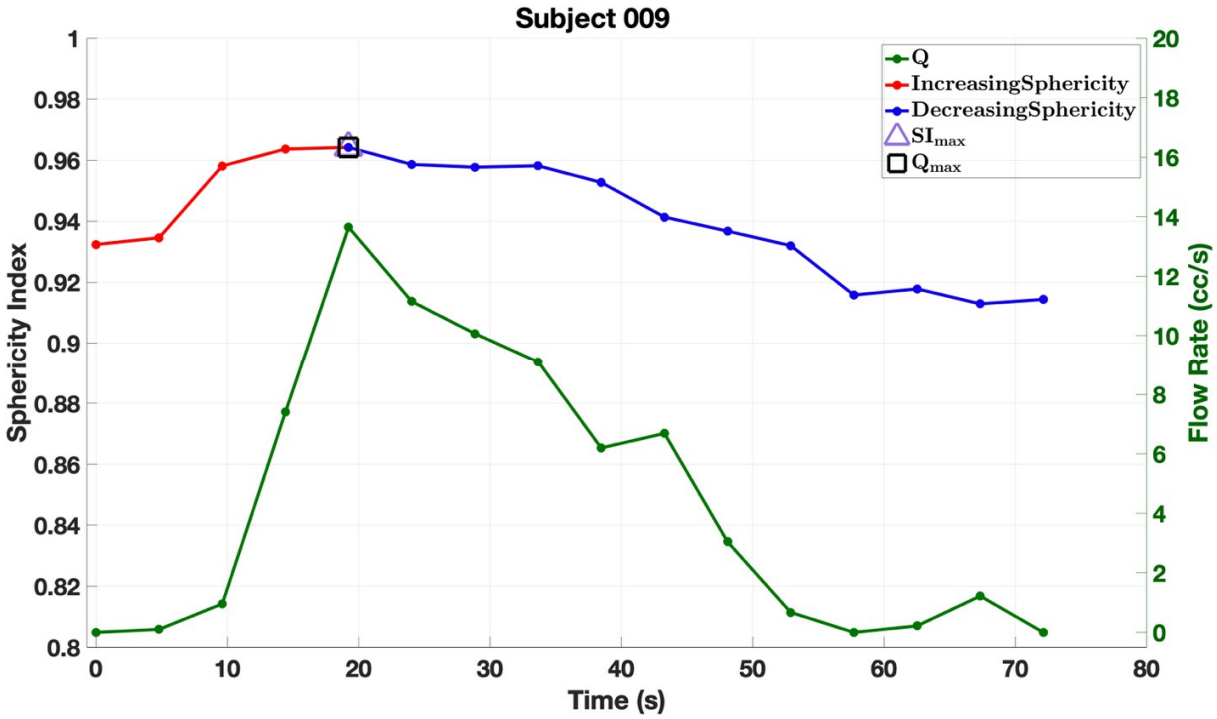

Subject 004
Q
IncreasingSphericity
DecreasingSphericity
SImax
Qmax
Sphericity Index
Flow Rate (cc/s)
Time (s)
1
0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
0.82
0.8
15
10
5
0
0
10
20
30
40
50
60
70
80
90
100

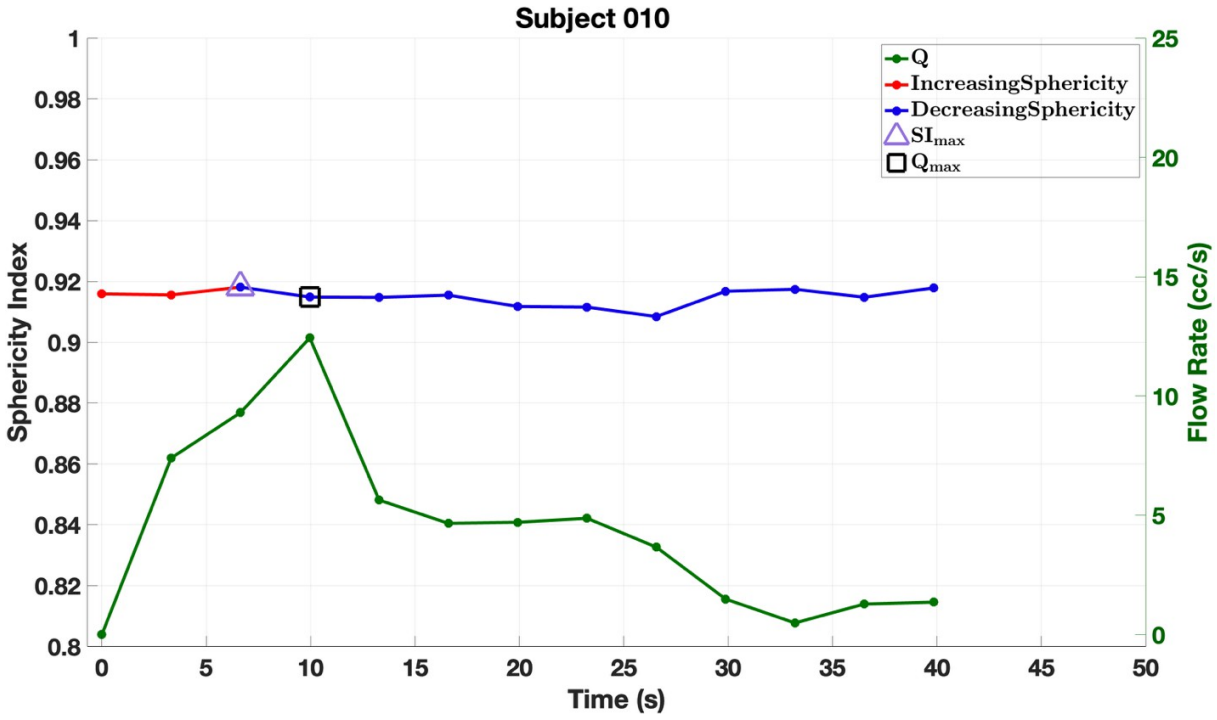

Subject 005
Q
IncreasingSphericity
DecreasingSphericity
SImax
Qmax
Sphericity Index
Flow Rate (cc/s)
Time (s)
1
0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
0.82
0.8
25
20
15
10
5
0
0
10
20
30
40
50
60
70
80

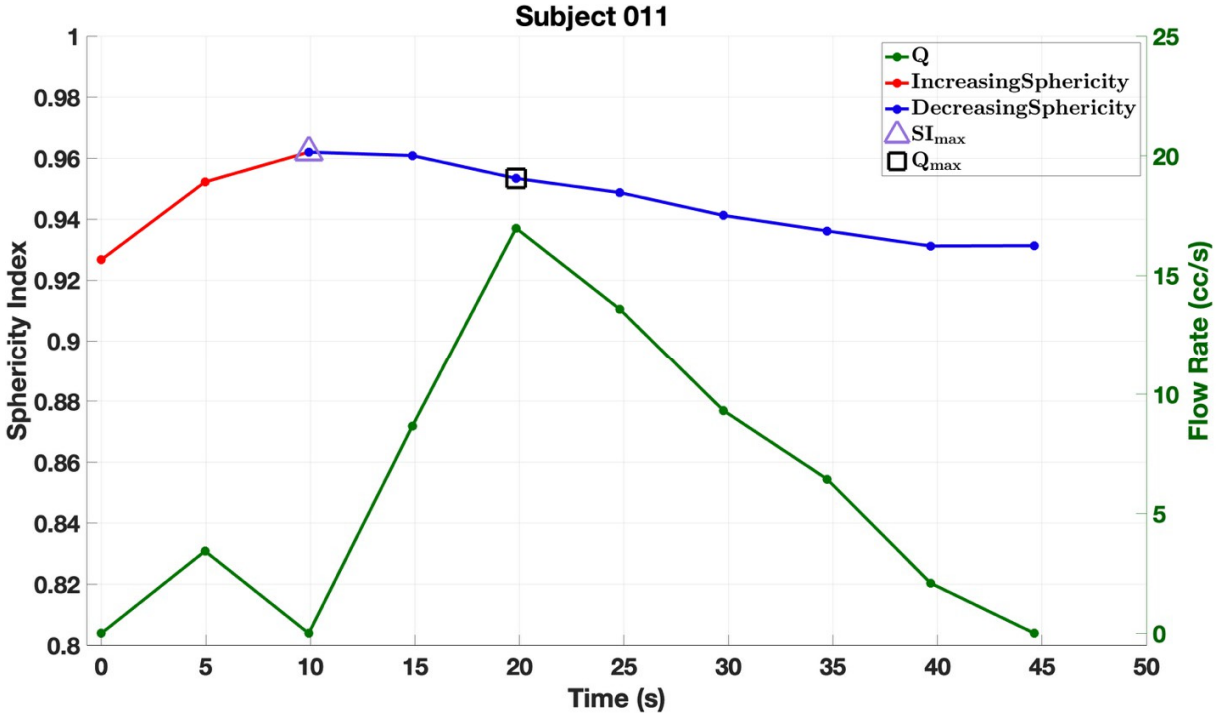

Subject 006
Sphericity Index
Flow Rate (cc/s)
Time (s)
Q
IncreasingSphericity
DecreasingSphericity
SImax
Qmax


Subject 007
Sphericity Index
Flow Rate (cc/s)
Time (s)
Q
IncreasingSphericity
DecreasingSphericity
SImax
Qmax


Subject 008
Sphericity Index
Flow Rate (cc/s)
Time (s)
Q
IncreasingSphericity
DecreasingSphericity
SImax
Qmax

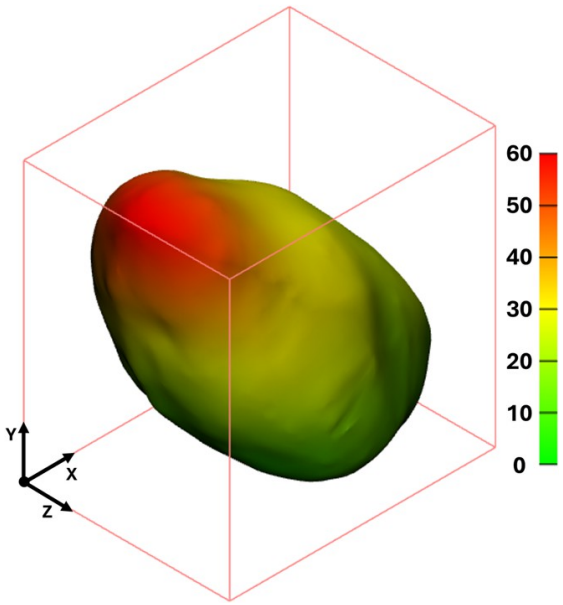

Subject 009
Sphericity Index
Flow Rate (cc/s)
Time (s)
Q
IncreasingSphericity
DecreasingSphericity
SImax
Qmax


Subject 010
Q
IncreasingSphericity
DecreasingSphericity
SImax
Qmax
Sphericity Index
Flow Rate (cc/s)
Time (s)
1
0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
0.82
0.8
25
20
15
10
5
0
0
5
10
15
20
25
30
35
40
45
50

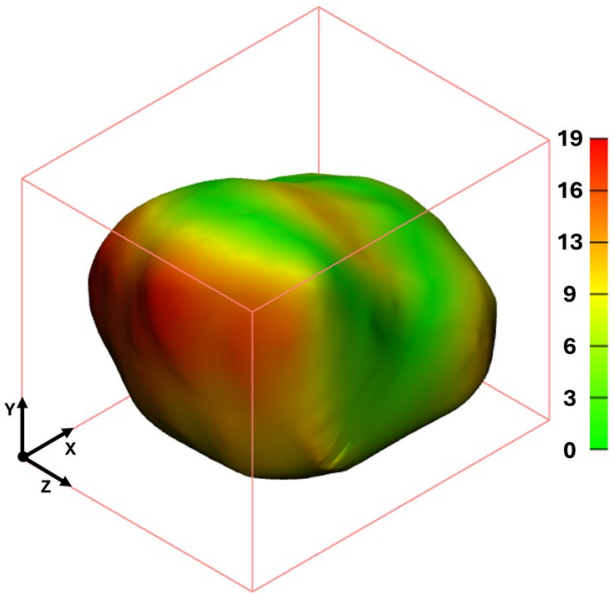

Subject 011
Q
IncreasingSphericity
DecreasingSphericity
SImax
Qmax
Sphericity Index
Flow Rate (cc/s)
Time (s)
1
0.98
0.96
0.94
0.92
0.9
0.88
0.86
0.84
0.82
0.8
25
20
15
10
5
0
0
5
10
15
20
25
30
35
40
45
50

Supplementary Materials S2: Deformation Maps

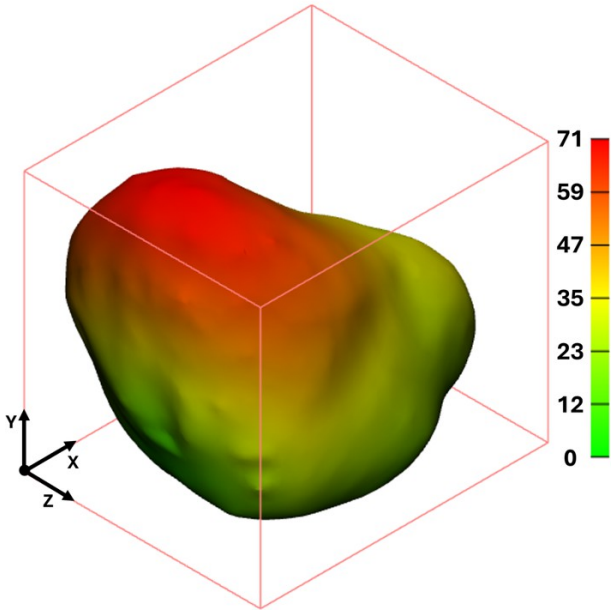
Subject 002



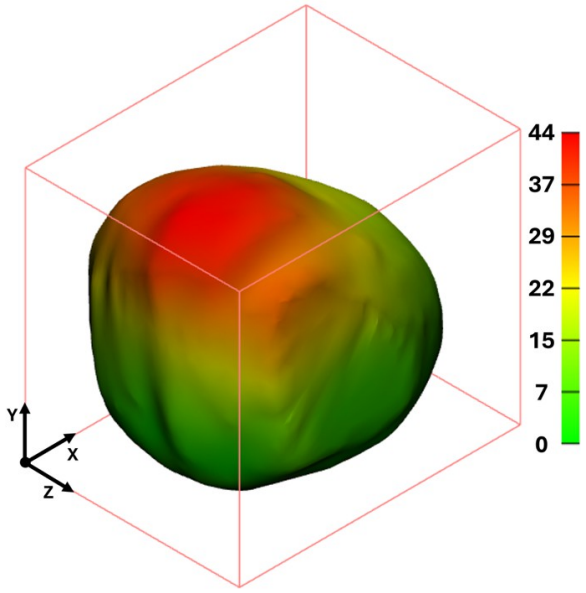
Subject 004



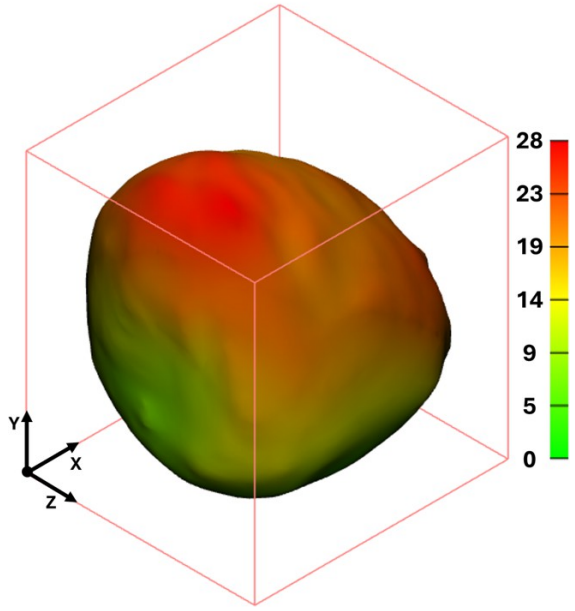
Subject 005



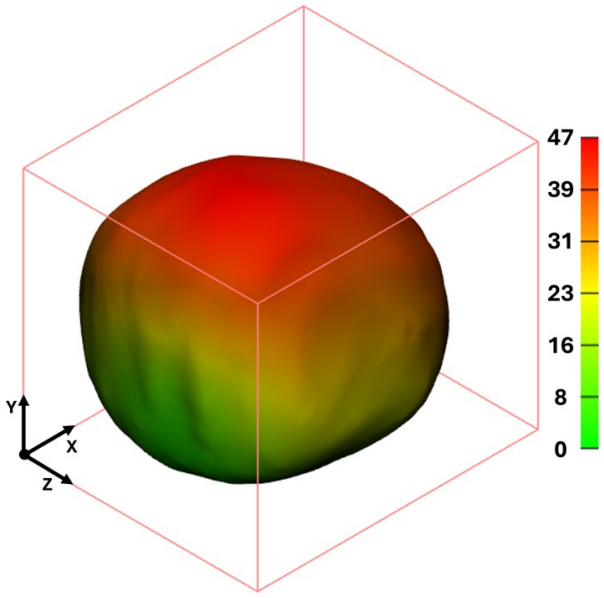
Subject 006



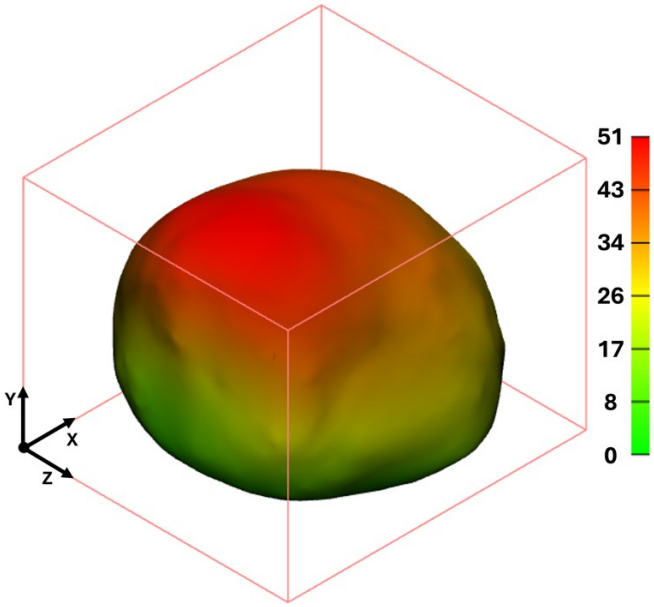
Subject 007



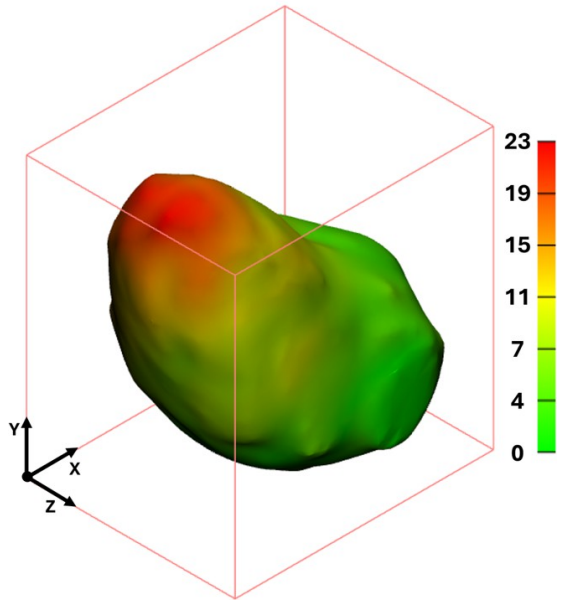
Subject 008

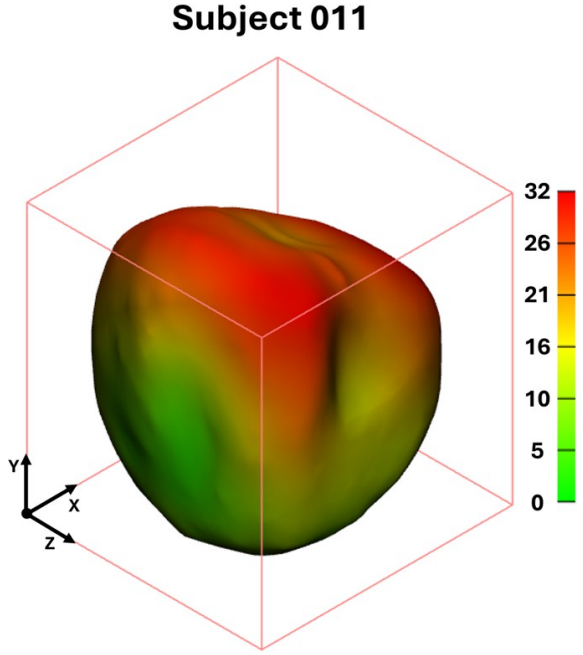


Subject 009

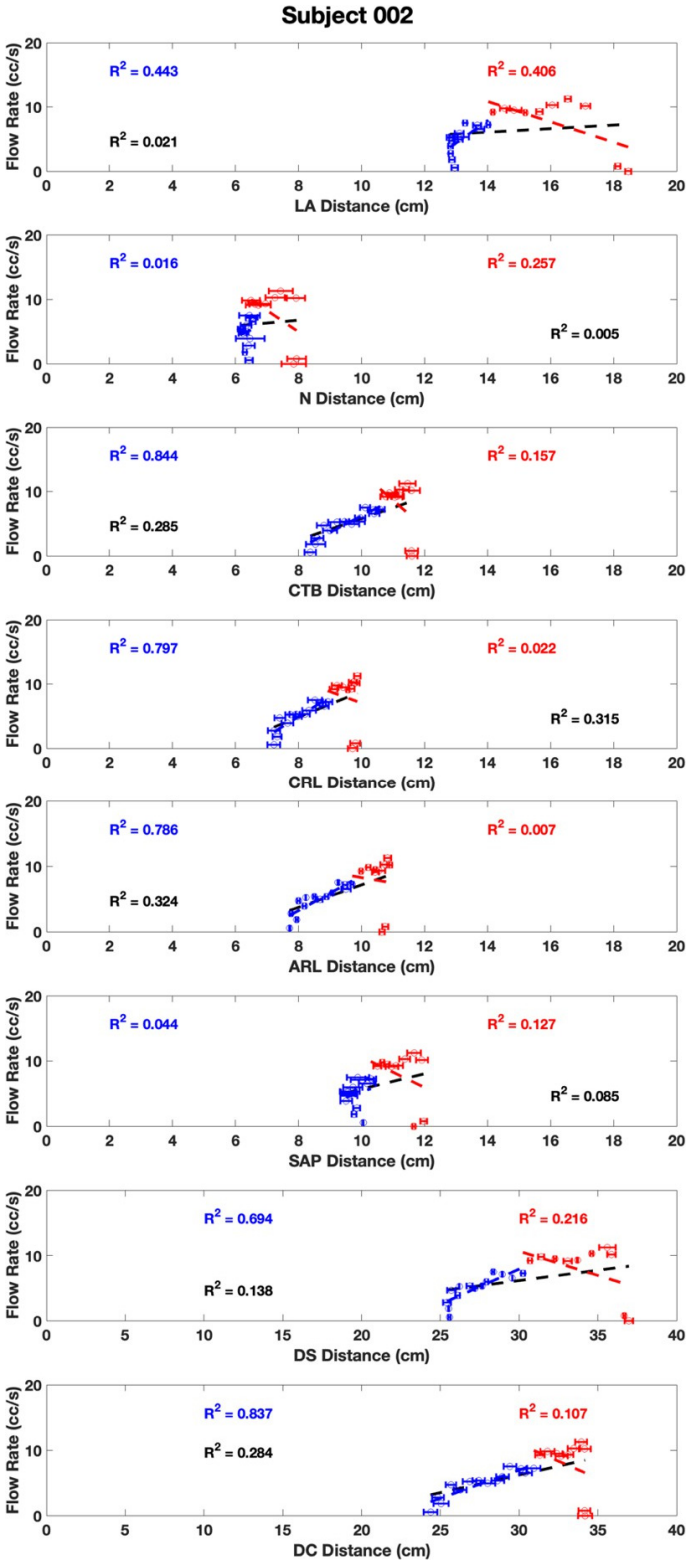


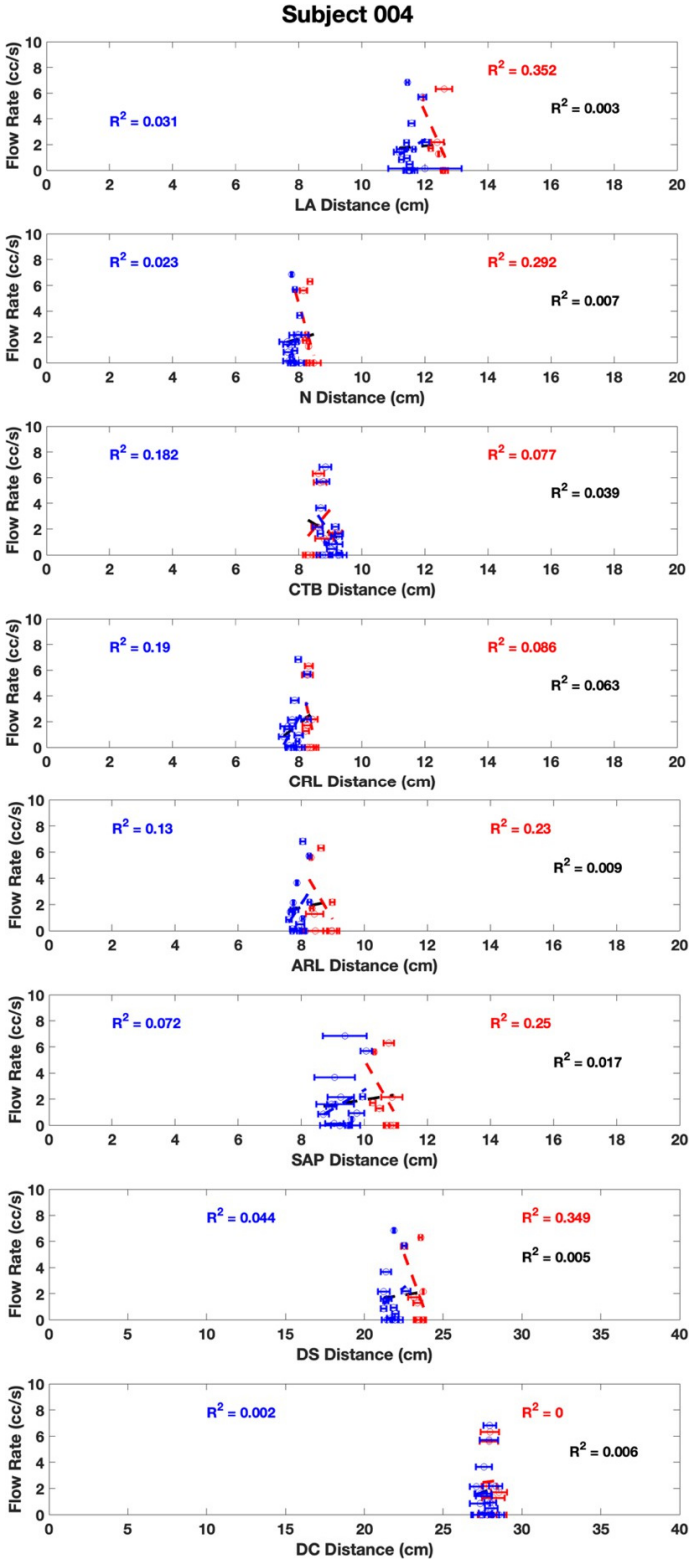
Subject 010

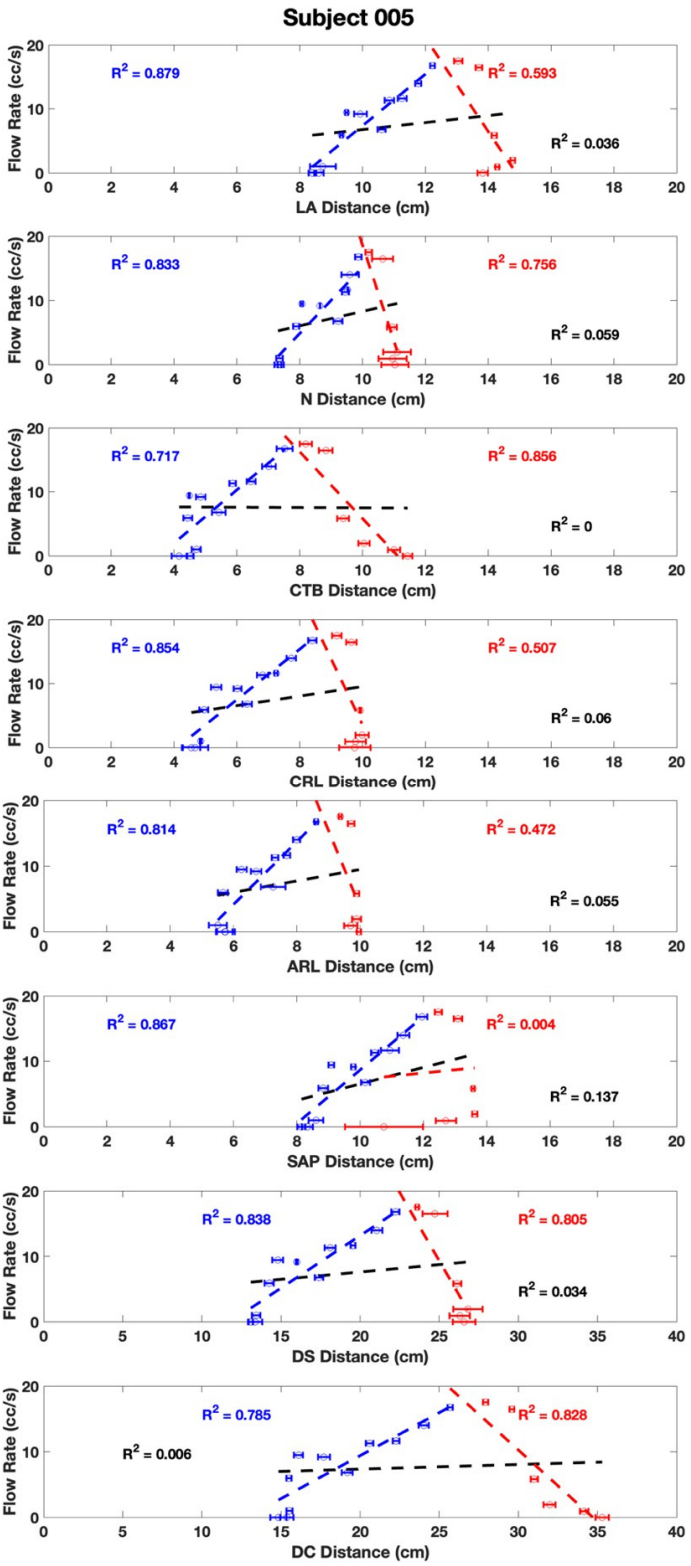


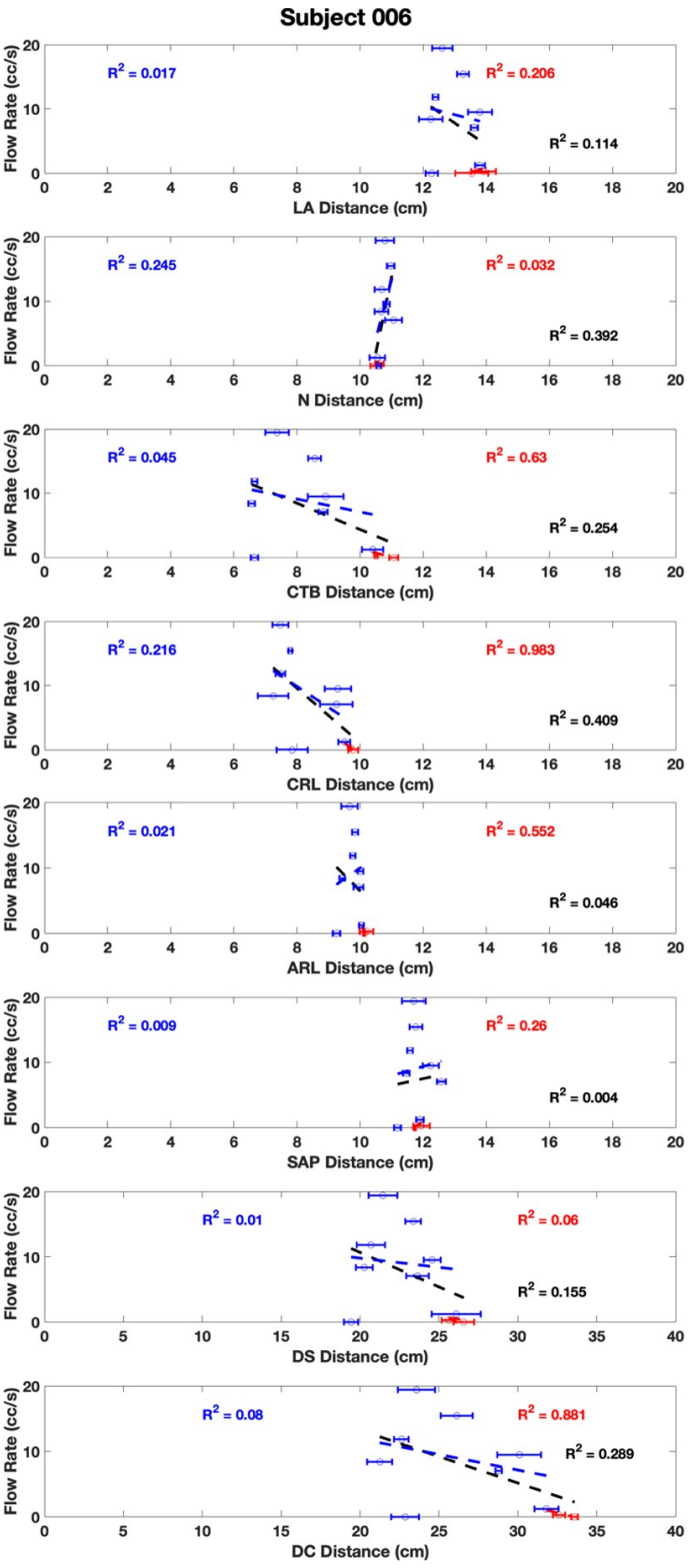

Subject 011
32
26
21
16
10
5
0
Y
X
Z

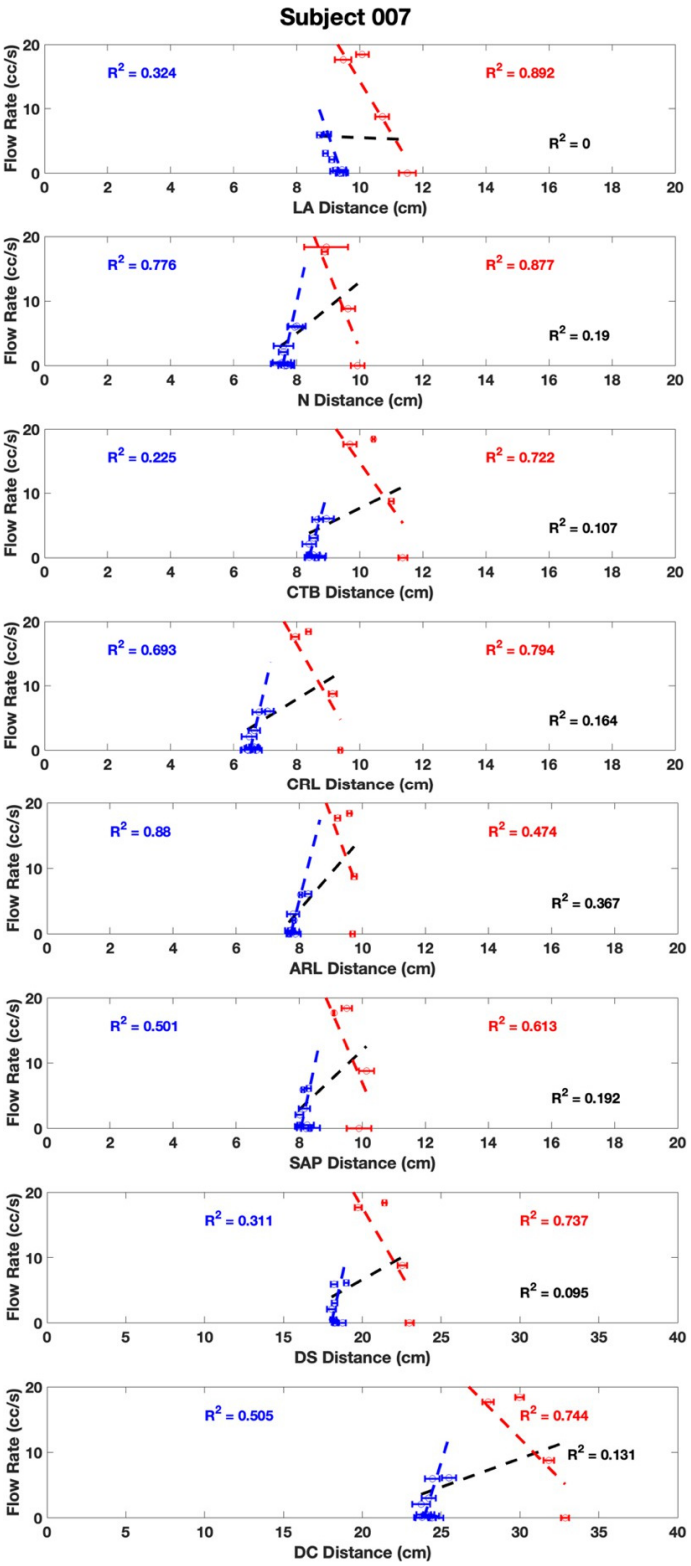
Supplementary Materials S3: Anatomical Measurements Correlated with Flow Rate



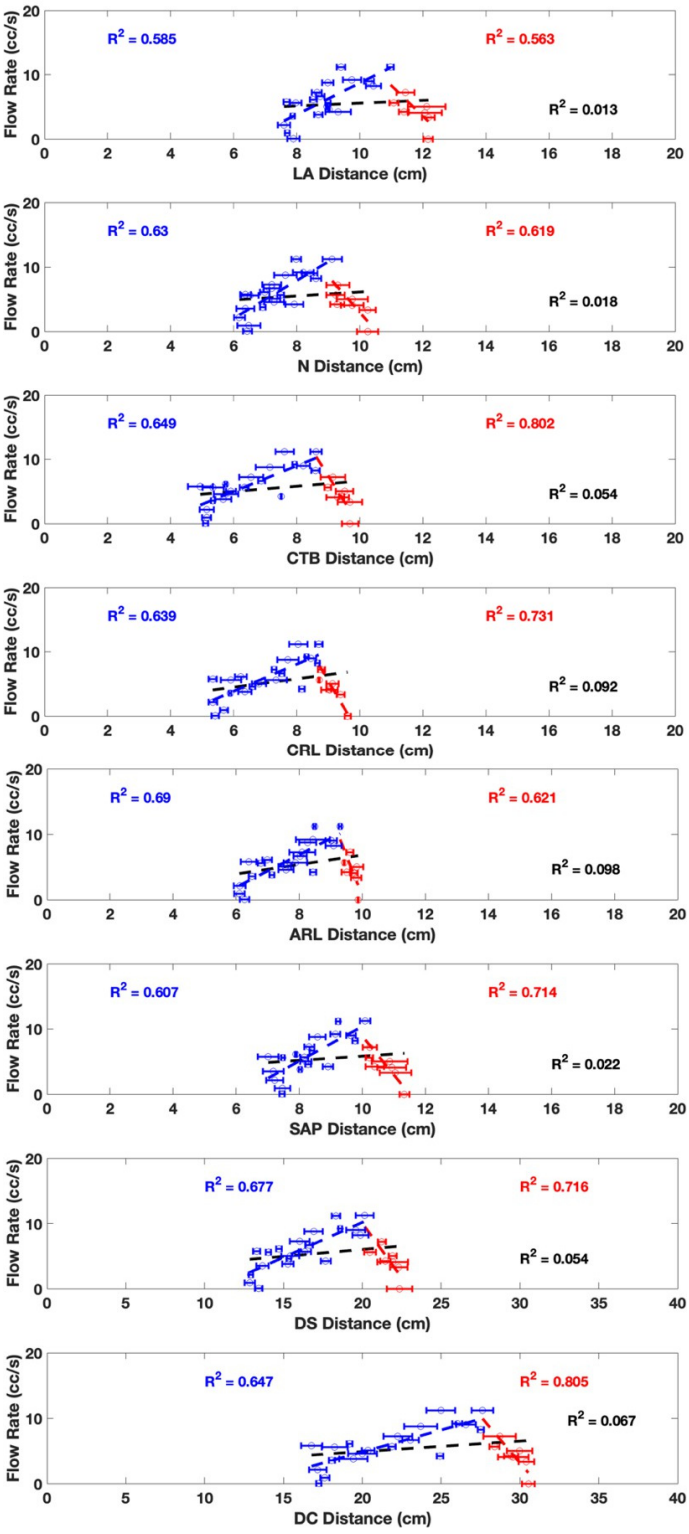

Subject 004
Flow Rate (cc/s)
LA Distance (cm)
R2 = 0.031
R2 = 0.352
R2 = 0.003
N Distance (cm)
R2 = 0.023
R2 = 0.292
R2 = 0.007
CTB Distance (cm)
R2 = 0.182
R2 = 0.077
R2 = 0.039
CRL Distance (cm)
R2 = 0.19
R2 = 0.086
R2 = 0.063
ARL Distance (cm)
R2 = 0.13
R2 = 0.23
R2 = 0.009
SAP Distance (cm)
R2 = 0.072
R2 = 0.25
R2 = 0.017
DS Distance (cm)
R2 = 0.044
R2 = 0.349
R2 = 0.005
DC Distance (cm)
R2 = 0.002
R2 = 0
R2 = 0.006

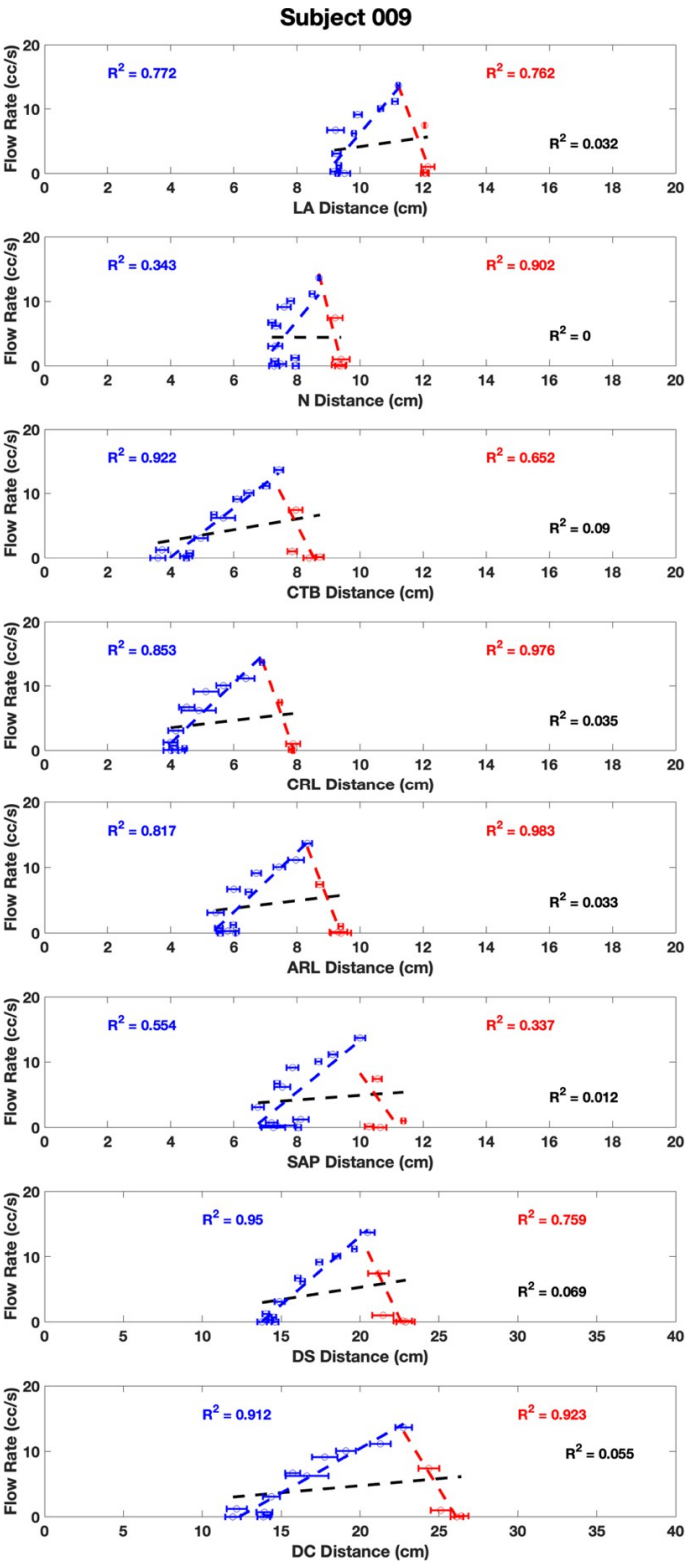

Subject 005
Flow Rate (cc/s)
R2 = 0.879
R2 = 0.593
R2 = 0.036
LA Distance (cm)
R2 = 0.833
R2 = 0.756
R2 = 0.059
N Distance (cm)
R2 = 0.717
R2 = 0.856
R2 = 0
CTB Distance (cm)
R2 = 0.854
R2 = 0.507
R2 = 0.06
CRL Distance (cm)
R2 = 0.814
R2 = 0.472
R2 = 0.055
ARL Distance (cm)
R2 = 0.867
R2 = 0.004
R2 = 0.137
SAP Distance (cm)
R2 = 0.838
R2 = 0.805
R2 = 0.034
DS Distance (cm)
R2 = 0.785
R2 = 0.828
R2 = 0.006
DC Distance (cm)

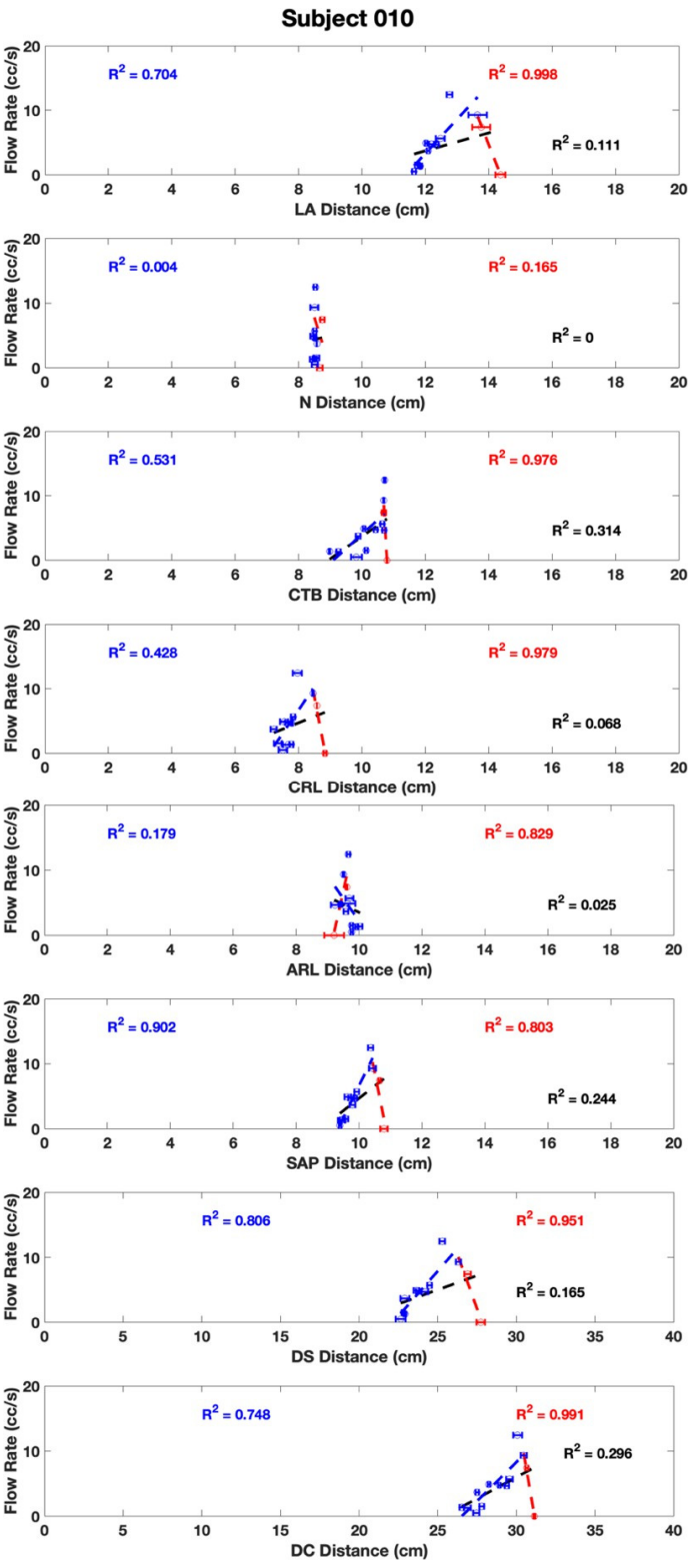

Subject 006
Flow Rate (cc/s)
R2 = 0.017
R2 = 0.206
R2 = 0.114
LA Distance (cm)
R2 = 0.245
R2 = 0.032
R2 = 0.392
N Distance (cm)
R2 = 0.045
R2 = 0.63
R2 = 0.254
CTB Distance (cm)
R2 = 0.216
R2 = 0.983
R2 = 0.409
CRL Distance (cm)
R2 = 0.021
R2 = 0.552
R2 = 0.046
ARL Distance (cm)
R2 = 0.009
R2 = 0.26
R2 = 0.004
SAP Distance (cm)
R2 = 0.01
R2 = 0.06
R2 = 0.155
DS Distance (cm)
R2 = 0.08
R2 = 0.881
R2 = 0.289
DC Distance (cm)

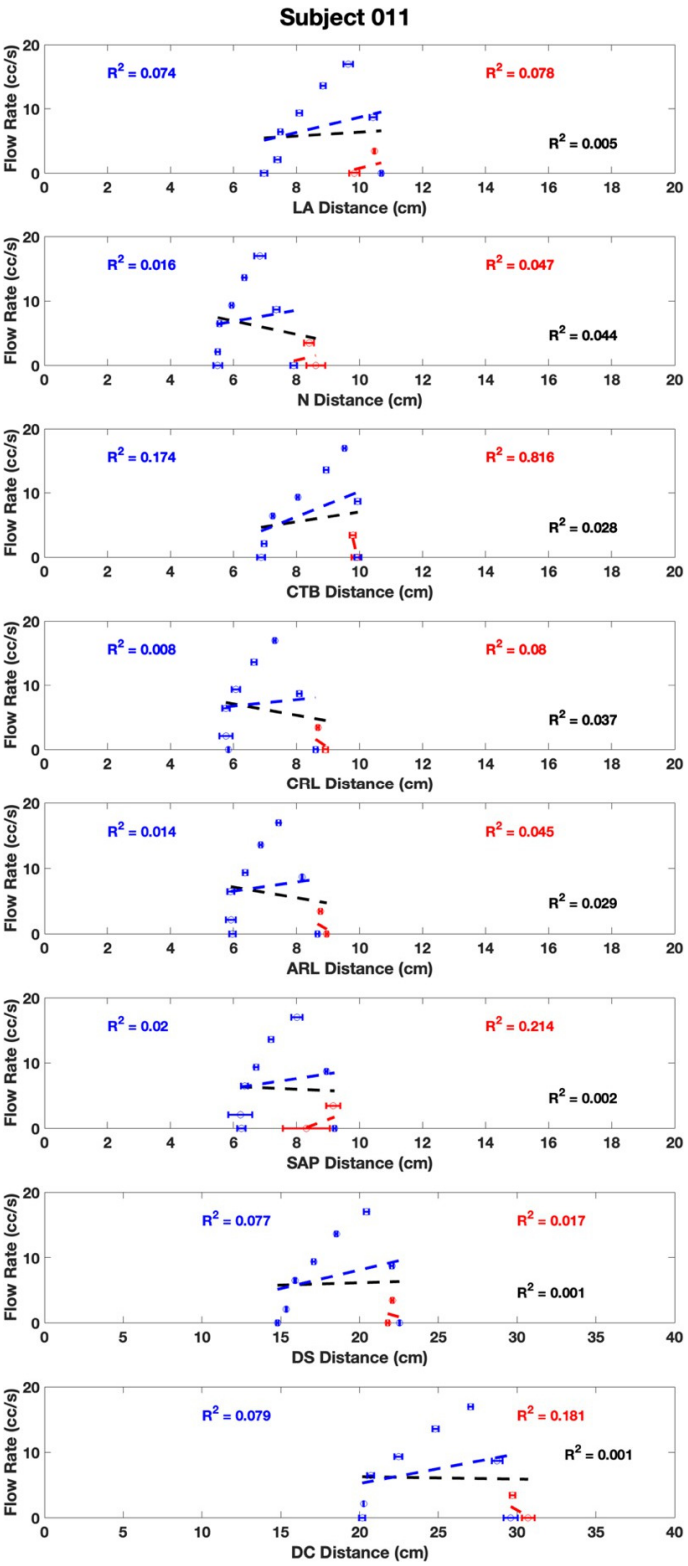

Subject 007
Flow Rate (cc/s)
R2 = 0.324
R2 = 0.892
R2 = 0
LA Distance (cm)
R2 = 0.776
R2 = 0.877
R2 = 0.19
N Distance (cm)
R2 = 0.225
R2 = 0.722
R2 = 0.107
CTB Distance (cm)
R2 = 0.693
R2 = 0.794
R2 = 0.164
CRL Distance (cm)
R2 = 0.88
R2 = 0.474
R2 = 0.367
ARL Distance (cm)
R2 = 0.501
R2 = 0.613
R2 = 0.192
SAP Distance (cm)
R2 = 0.311
R2 = 0.737
R2 = 0.095
DS Distance (cm)
R2 = 0.505
R2 = 0.744
R2 = 0.131
DC Distance (cm)

Subject 008

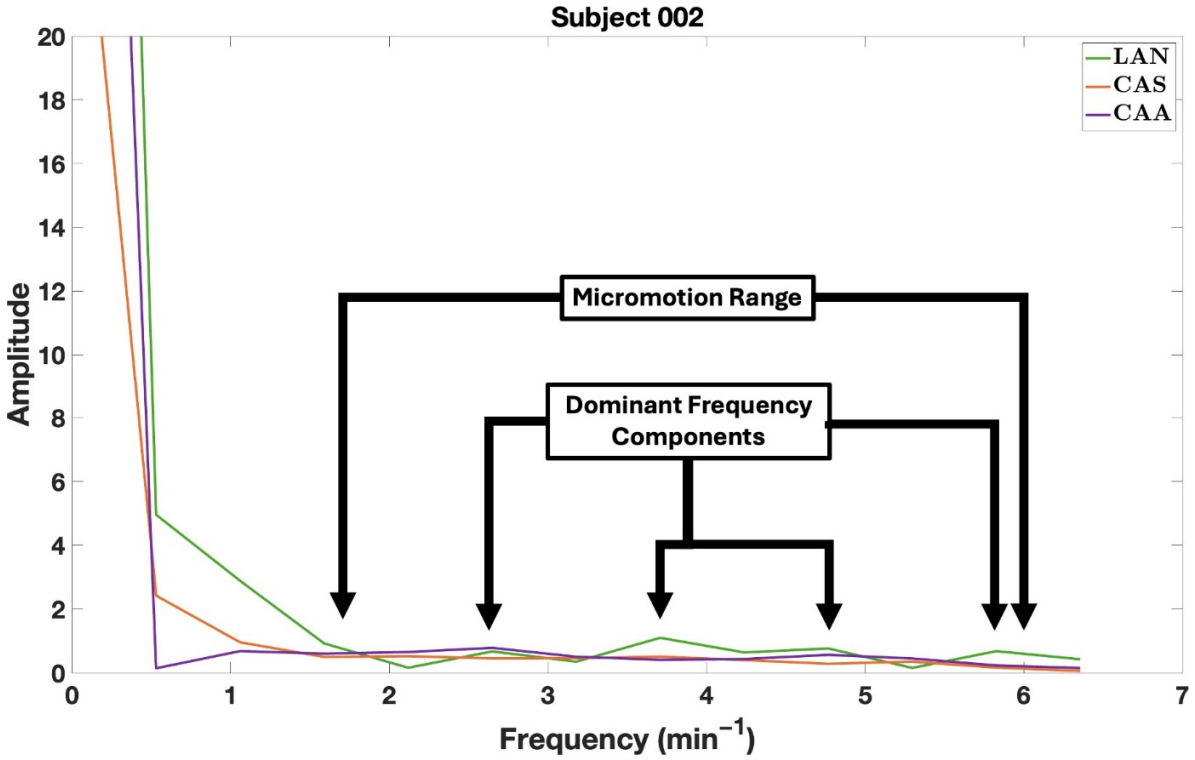

R² = 0.585
R² = 0.563
R² = 0.013
Flow Rate (cc/s)
LA Distance (cm)
R² = 0.63
R² = 0.619
R² = 0.018
N Distance (cm)
R² = 0.649
R² = 0.802
R² = 0.054
CTB Distance (cm)
R² = 0.639
R² = 0.731
R² = 0.092
CRL Distance (cm)
R² = 0.69
R² = 0.621
R² = 0.098
ARL Distance (cm)
R² = 0.607
R² = 0.714
R² = 0.022
SAP Distance (cm)
R² = 0.677
R² = 0.716
R² = 0.054
DS Distance (cm)
R² = 0.647
R² = 0.805
R² = 0.067
DC Distance (cm)

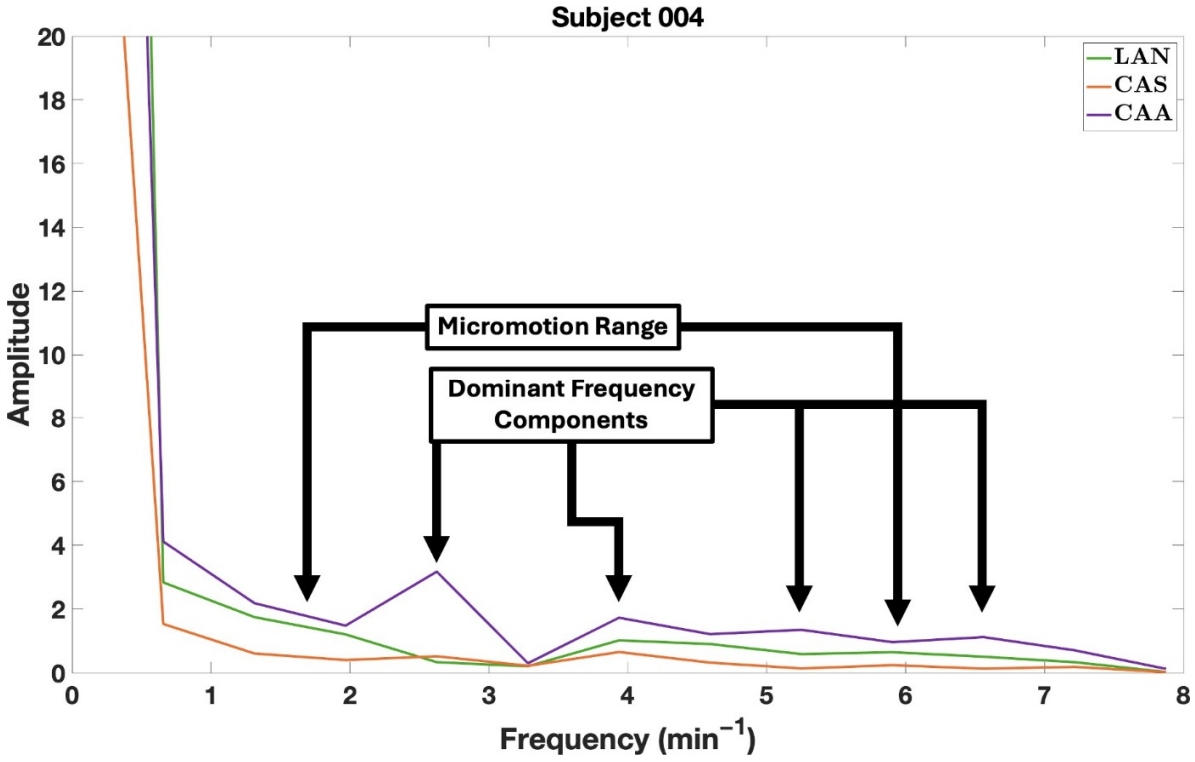

Subject 009
Flow Rate (cc/s)
R2 = 0.772
R2 = 0.762
R2 = 0.032
LA Distance (cm)
R2 = 0.343
R2 = 0.902
R2 = 0
N Distance (cm)
R2 = 0.922
R2 = 0.652
R2 = 0.09
CTB Distance (cm)
R2 = 0.853
R2 = 0.976
R2 = 0.035
CRL Distance (cm)
R2 = 0.817
R2 = 0.983
R2 = 0.033
ARL Distance (cm)
R2 = 0.554
R2 = 0.337
R2 = 0.012
SAP Distance (cm)
R2 = 0.95
R2 = 0.759
R2 = 0.069
DS Distance (cm)
R2 = 0.912
R2 = 0.923
R2 = 0.055
DC Distance (cm)

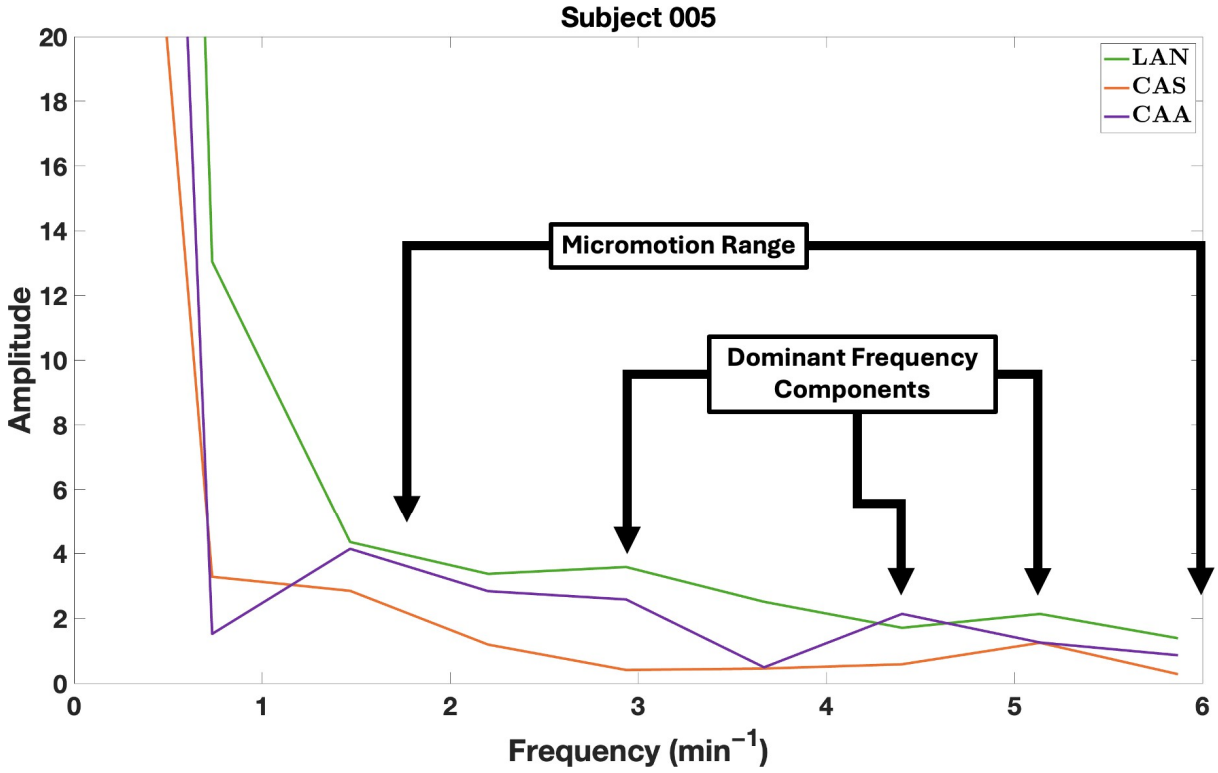

Subject 010
R2 = 0.704
R2 = 0.998
R2 = 0.111
Flow Rate (cc/s)
LA Distance (cm)
R2 = 0.004
R2 = 0.165
R2 = 0
N Distance (cm)
R2 = 0.531
R2 = 0.976
R2 = 0.314
CTB Distance (cm)
R2 = 0.428
R2 = 0.979
R2 = 0.068
CRL Distance (cm)
R2 = 0.179
R2 = 0.829
R2 = 0.025
ARL Distance (cm)
R2 = 0.902
R2 = 0.803
R2 = 0.244
SAP Distance (cm)
R2 = 0.806
R2 = 0.951
R2 = 0.165
DS Distance (cm)
R2 = 0.748
R2 = 0.991
R2 = 0.296
DC Distance (cm)

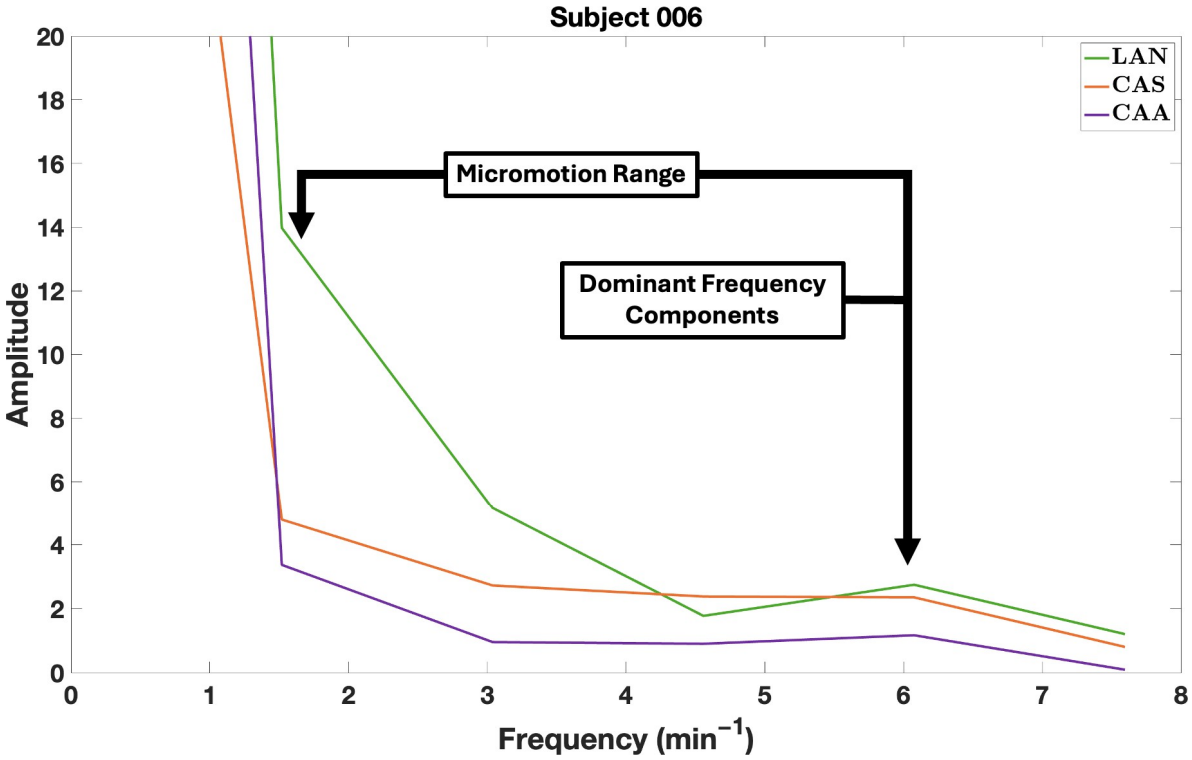

Subject 011
Flow Rate (cc/s)
R2 = 0.074
R2 = 0.078
R2 = 0.005
LA Distance (cm)
R2 = 0.016
R2 = 0.047
R2 = 0.044
N Distance (cm)
R2 = 0.174
R2 = 0.816
R2 = 0.028
CTB Distance (cm)
R2 = 0.008
R2 = 0.08
R2 = 0.037
CRL Distance (cm)
R2 = 0.014
R2 = 0.045
R2 = 0.029
ARL Distance (cm)
R2 = 0.02
R2 = 0.214
R2 = 0.002
SAP Distance (cm)
R2 = 0.077
R2 = 0.017
R2 = 0.001
DS Distance (cm)
R2 = 0.079
R2 = 0.181
R2 = 0.001
DC Distance (cm)

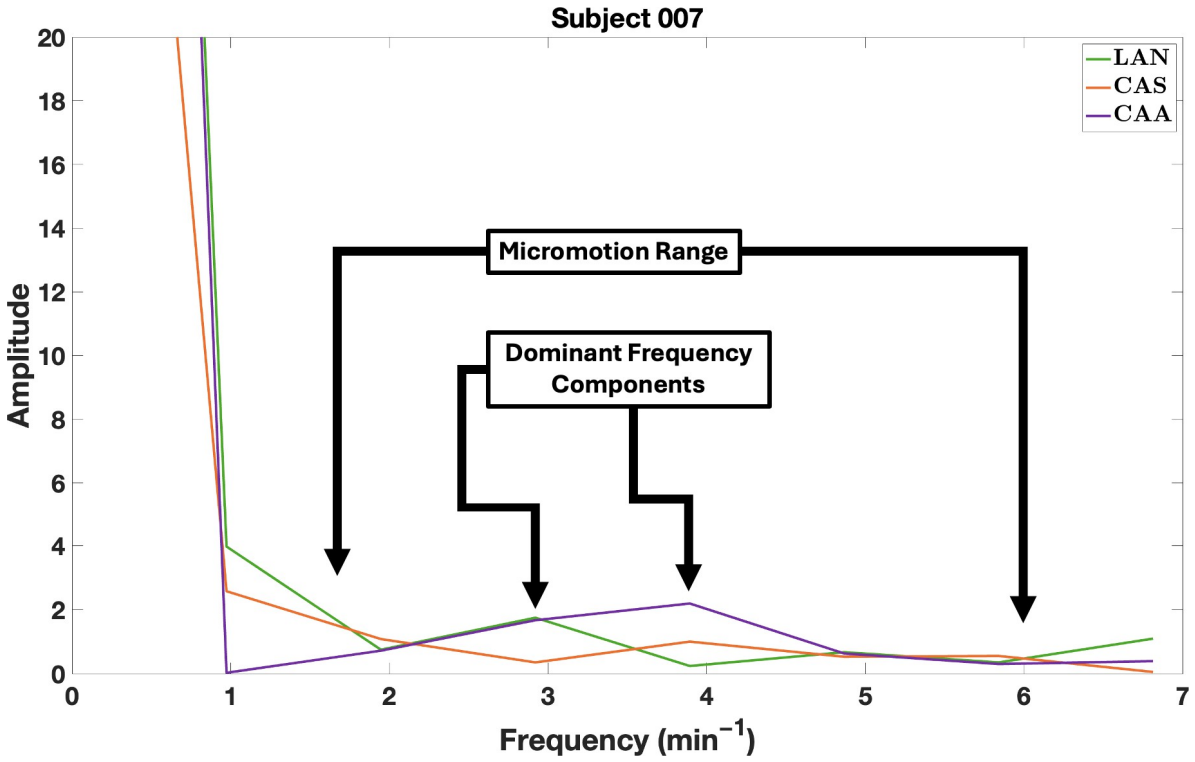
Supplementary Materials S4: Rotation and Contraction; Frequency Decompositions

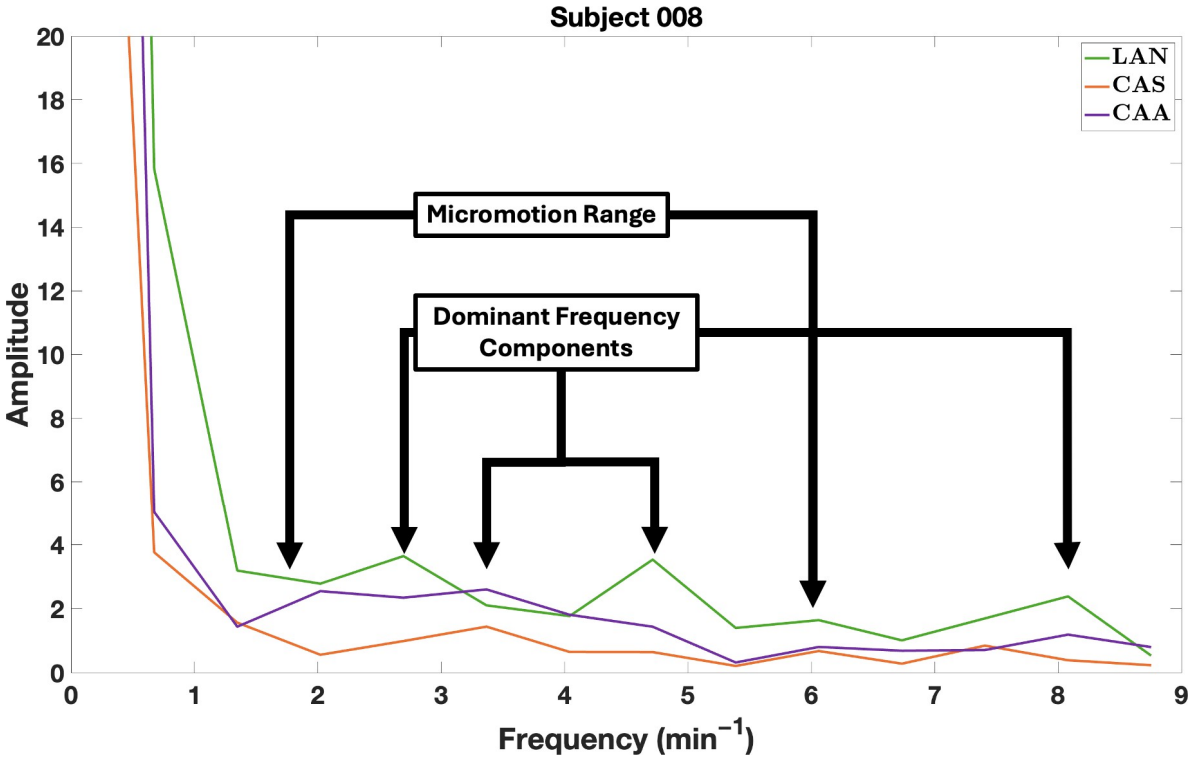


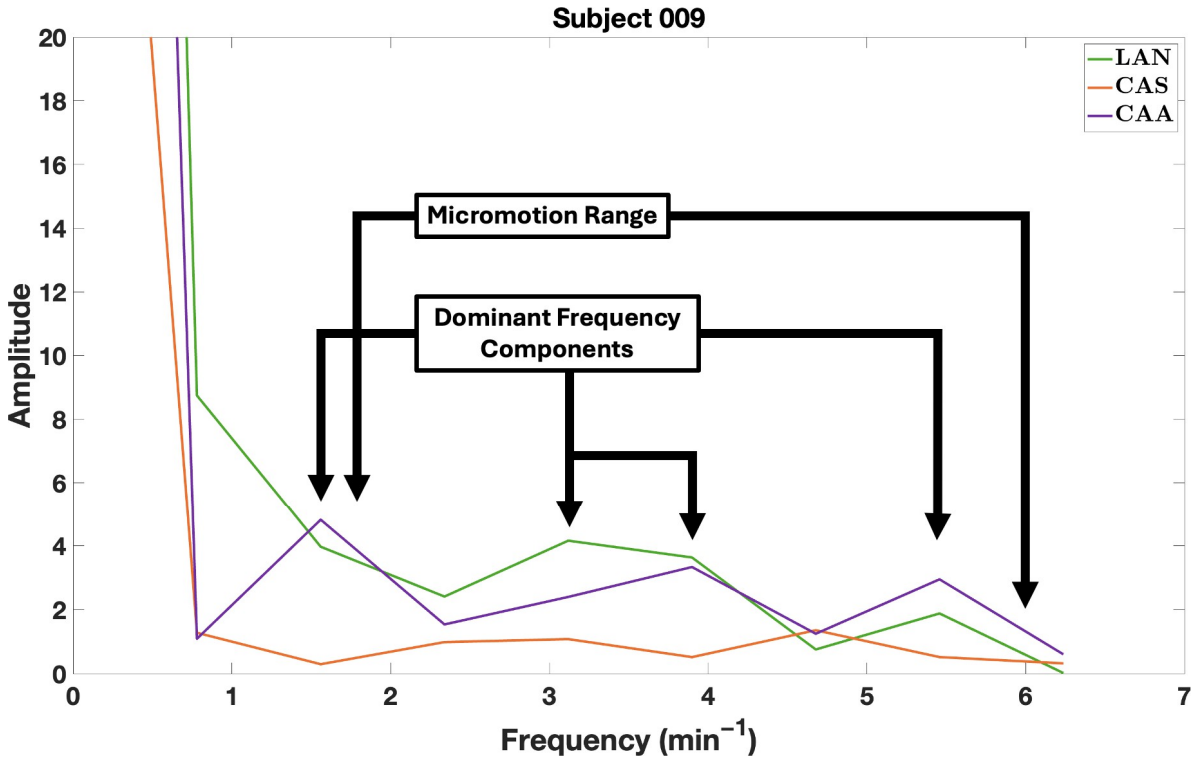


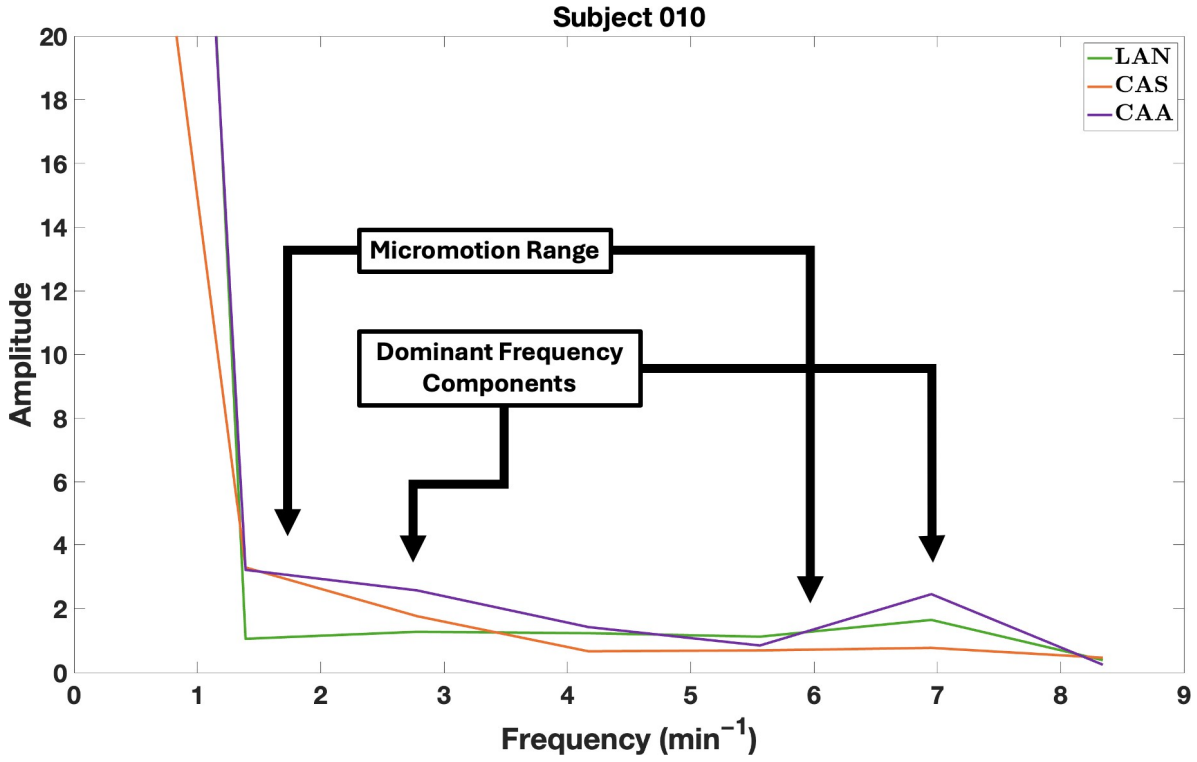

Subject 005
LAN
CAS
CAA
Micromotion Range
Dominant Frequency Components
Amplitude
Frequency (min^{-1})
0
2
4
6
8
10
12
14
16
18
20
1
3
5

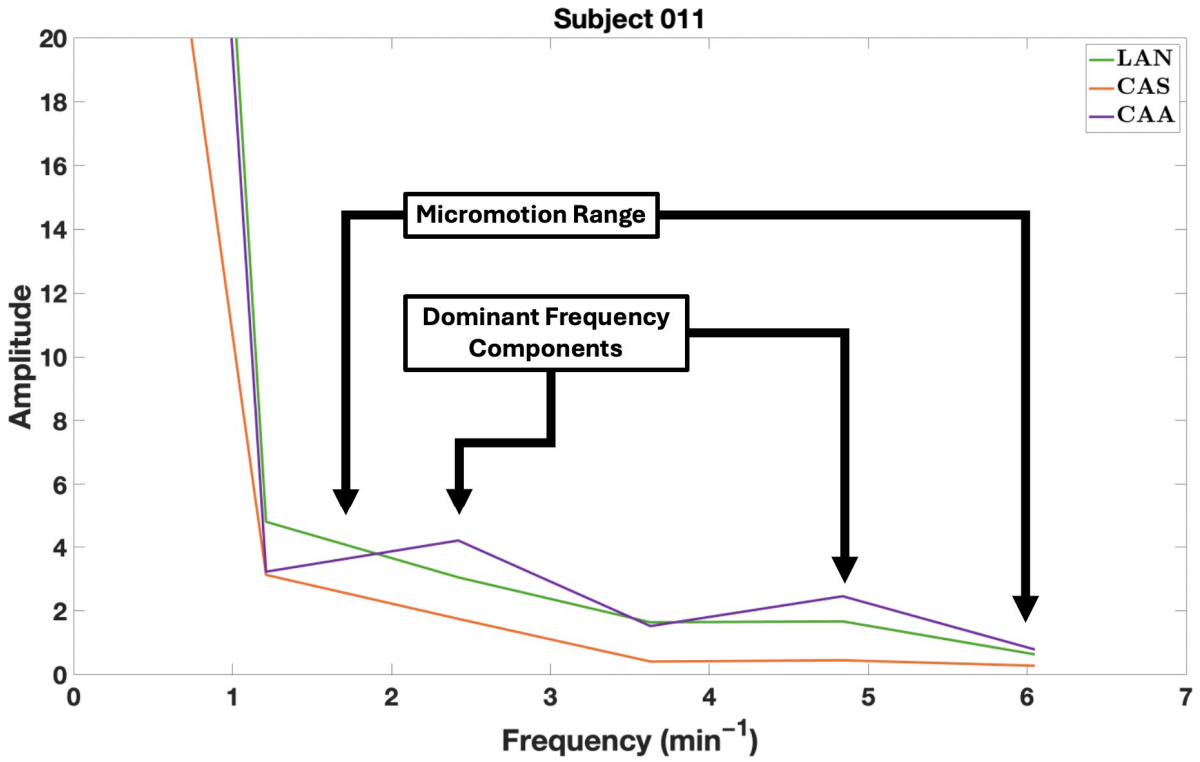

Subject 006
LAN
CAS
CAA
Micromotion Range
Dominant Frequency Components
Amplitude
Frequency (min^{-1})
0
2
4
6
8
10
12
14
16
18
20
1
3
5
7


Subject 007
LAN
CAS
CAA
Micromotion Range
Dominant Frequency Components
Amplitude
Frequency (min^{-1})
0
2
4
6
8
10
12
14
16
18
20
0
1
2
3
4
5
6
7


Subject 008
LAN
CAS
CAA
Micromotion Range
Dominant Frequency Components
Amplitude
Frequency (min^{-1})
0
2
4
6
8
10
12
14
16
18
20
0
1
2
3
4
5
6
7
8
9


Subject 009
LAN
CAS
CAA
Micromotion Range
Dominant Frequency Components
Amplitude
Frequency (min^{-1})


Subject 010
LAN
CAS
CAA
Micromotion Range
Dominant Frequency Components
Amplitude
Frequency (min^{-1})


Subject 011
LAN
CAS
CAA
Micromotion Range
Dominant Frequency Components
Amplitude
Frequency (min^{-1})
0
2
4
6
8
10
12
14
16
18
20
0
1
2
3
4
5
6
7