Hands on: Regularity of movement

Using two different data sets, you will try implementing sample entropy as a tool for quantification of regularity in a time series. The two data sets are:

- Isometric force data from low intensity tibialis anterior muscle contraction from children and young adults.
- Center of pressure data from unilateral and bilateral stance in 5 young adults.

The data sets can be found in the folder Data and the Matlab scripts needed, can be found the folder script.

Isometric force

1. Open and plot the non-filtered force data from the young adults (Force_YA_NF.mat).
2. Calculate sample entropy (Samp_Ent.m) using standard values for m and r (m=2, r=0.2).
    a. Try calculating it for all five time series.
3. Open and plot the wavelet filtered force data from the young adults (Force_YA_WF.mat).
    a. Try plotting it in the same figure as the non-filtered data.
4. Calculate sample entropy using standard values for m and r (m=2, r=0.2).
    a. Try calculating it for all five time series. Compare sample entropy values from filtered and non-filtered data.
5. Open and plot the wavelet filtered data from children and young adults (Force_CH_YA_WF.mat).
6. Calculate sample entropy using standard values for m and r (m=2, r=0.2) for all the time series.
    a. Compare sample entropy from the two groups.

Center of pressure

1. Open and plot both the unfiltered (CoP_AP.dataUF/ CoP_ML.dataUF) and wavelet filtered (CoP_AP.dataFUD/ CoP_ML.dataFUD) CoP data for both anterior-posterior direction and mediolateral direction.
    a. Try to zoom in on the data.
2. Open and plot the wavelet filtered and downsampled CoP data (CoP_AP.data/ CoP_ML.data) both anterior-posterior direction and mediolateral direction.
    a. Separate data from the eyes open trials and eyes closed trials.
3. Calculate sample entropy using standard values for m and r (m=2, r=0.2) for all the time series and compare between directions and between eyes open and eyes closed trials.
4. Check the parameter consistency by changing m, r and data series length (N).
    a. Try different combinations of m={2 3}, r={0.1 0.15 0.2 0.25 0.3} and N = {100 200 500 1000 1500 1999}.
    b. Are the differences between directions and between eyes open and eyes closed trials the same for various input parameters?

Questions

What is the effect of filtering data on sample entropy?

What is the effect of changing input parameters?

What is the effect of changing time series length?

Hands on: Complexity of movement

Using one data set, you will try implementing multiscale entropy as a tool for quantification of complexity in a time series.

Isometric force

1. Open the wavelet filtered data from children and young adults (Force_CH_YA_WF.mat).
2. Calculate multiscale entropy (MS_Ent.m) using standard values for m and r (m=2, r=0.2) and a scale index of 6 for all the time series.
3. Plot the sample entropy across the six scales for the two groups.
4. Calculate complexity index (area below the curve) and compare it between the two groups.
5. Check the parameter consistency by changing m, r and data series length (N).
    a. Try different combinations of m={2 3}, r={0.1 0.2 0.3} and N = {1000 5000 8000 11000}.
    b. Is the difference between groups the same for various input parameters?
    c. Try increasing or decreasing the number of scales

Note: The script MS_Ent.m calculates sample entropy for one specific scale. Make a 'for i=1"6' loop to calculate sample entropy across 6 scales.

Scripts:

Samp_Ent.m

MS_Ent.m

Files:

Wavelet filtered and non-filtered force data

- Force_YA_NF.mat (young adults, not filtered)
- Force_YA_WF.mat (young adults, wavelet filtered)
- Force_CH_YA_WF.mat (5 children + 5 young adults)

Center of pressure data during upright stance in 5 young adults with either eyes open (#1, #3, #5, #7 #9 time series) and eyes closed (#2, #4, #6, #8, #10 time series)

- CoP_AP
    - CoP_AP.dataUF: unfiltered center of pressure data in the anterior-posterior direction
    - CoP_AP.dataFUD: wavelet filtered non-downsampled center of pressure data in the anterior-posterior direction
    - CoP_AP.data: wavelet filtered downsampled center of pressure data in the anterior-posterior direction
- CoP_ML
    - CoP_ML.dataUF: unfiltered center of pressure data in the mediolateral direction
    - CoP_ML.dataFUD: wavelet filtered non-downsampled center of pressure data in the mediolateral direction
    - CoP_ML.data: wavelet filtered downsampled center of pressure data in the mediolateral direction