Title: Determination of ejection duration and flow model using pressure curves
Project Number: Project3_02
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Attachments: Project3_02_Data.mat

The ejection duration is the time from the beginning of a beat to the dicrotic notch which marks the end of the systole. It is used to assess the functionality of the heart.

Often blood flow measurements to accompany the pulse wave recordings are not available due to various reasons. However, an approximation of blood flow can be calculated from the pulse wave. Many different approaches exist in literature. The triangular model is a basic model which uses the times of the onset of the beat, of the inflection point of the curve which corresponds to the return of the reflections from the arterial system and of the dicrotic notch to form a triangular shaped flow model.

The dataset consists of pressure curves 3 patients measured over 10 seconds with frequency 250Hz. For each patient also the systolic and diastolic blood pressure (sbp, dbp) is provided.

Tasks:

1. Filter the high-frequency noise from the signals in an appropriate way.
2. Split the signals in single beats (in an automated way).
3. Scale the beats such that the maximum is the systolic blood pressure (sbp) und the minimum is the diastolic blood pressure (dbp) for the regarding patient.
4. Use a 3-point-moving-average filter on the curves and save the filtered curves in a struct.
5. Locate the systolic peak for each beat (absolute maximum).
6. Locate the dicrotic notch for each single beat (first local minimum after systolic peak)
7. Calculate the ejection durations for all beats (time from beginning of the beat until the dicrotic notch) and combine them for each patient in an appropriate way.
8. Repeat steps 3-7 for the original, unfiltered signal. Use single beats from step 2.
9. Compare the results for the filtered and the unfiltered signal for each beat for each patient with Bland-Altman-Plots and report your observations.

10. Calculate an average signal of the filtered single beats for each patient in an appropriate way.
11. Determine the inflection point of each averaged signal by evaluating the first positive to negative zero crossing of the second derivative of the signals.
12. An approximation for blood flow can be calculated based on the (averaged) pressure curves:
    - A basic concept is the triangular flow model. The flow is zero at the beginning of the beat, has its maximum at the time of the inflection point and is zero again at the time of the dicrotic notch. These points are connected linearly so the whole flow pattern during systole has the shape of a triangle.
    - Display (averaged) pressure and regarding flow curves together in plots.