



## Biosignal Processing

### Assignment 2: Implement PPG beat detection and quality index

Implement a Matlab function with the following interface:

**Input arguments:**

- PPG signal as column array
- sampling rate in Hz

**Output arguments:**

- Matrix with timing, amplitude, and quality index for each detected beat
- Optional: calculated pulse wave template

Implement the algorithm for pulse wave detection from photoplethysmography and quality index calculation as described in the presented paper from Gabriele Papini<sup>1</sup>. This includes:

1. Preprocessing of input signal
2. Pulse wave detection, beat localization, and amplitude measurement
3. Pulse wave template computation, correction factors, and template amplitude correction
4. Quality index computation for each pulse wave

Submit your Matlab code including all required scripts in Moodle by November 6, 2020. Submit only once per group.

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<sup>1</sup> Papini, Gabriele & Fonseca, Pedro & Eerikäinen, Linda & Overeem, Sebastiaan & Bergmans, Jan & Vullings, Rik. (2018). Sinus or not: a new beat detection algorithm based on a pulse morphology quality index to extract normal sinus rhythm beats from wrist-worn photoplethysmography recordings. Physiological Measurement. 39. 10.1088/1361-6579/aae7f8.

## Required Materials

The paper can be downloaded from

[https://www.researchgate.net/publication/328256630\\_Sinus\\_or\\_not\\_a\\_new\\_beat\\_detection\\_algorithm\\_based\\_on\\_a\\_pulse\\_morphology\\_quality\\_index\\_to\\_extract\\_normal\\_sinus\\_rhythm\\_beats\\_from\\_wrist-worn\\_photoplethysmography\\_recordings](https://www.researchgate.net/publication/328256630_Sinus_or_not_a_new_beat_detection_algorithm_based_on_a_pulse_morphology_quality_index_to_extract_normal_sinus_rhythm_beats_from_wrist-worn_photoplethysmography_recordings). The publication on the DTW barycenter averaging

(DBA) can be downloaded from

[https://www.researchgate.net/publication/220601732\\_A\\_global\\_averaging\\_method\\_for\\_dynamic\\_time\\_warping\\_with\\_applications\\_to\\_clustering](https://www.researchgate.net/publication/220601732_A_global_averaging_method_for_dynamic_time_warping_with_applications_to_clustering).

Note that Matlab provides a dynamic time warping function and that the author of the DBA algorithm provides Matlab code of the algorithm from his github repository

<https://github.com/fpetitjean/DBA>.

## Questions

If you have questions regarding the algorithm or your approach, please use the Moodle forum of the course to discuss amongst groups. This way your colleagues can profit from your questions as well. The lecturers will participate in the forum discussion and answer questions!

## Bonus:

The method described in the paper has a limitation in the refinement of pulse wave start and end times as the pulse wave can only become shorter during this refinement step in section 2.1. Up to 2 bonus points will be awarded for solutions that avoid this limitation.