RR Estimation from PPG and RR from Reference Respiratory Signal

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I. Objective

1) To present respiratory rate (RR) fusion results from PPG signals of 4 datasets.
2) To obtain the reference RR from the reference respiratory signal.
3) To present the statistical data of each datasets,

II. Methodology

In progress report 26, two algorithms, i.e. arspec.m and arxcor.m were used to calculate the respiratory rate (RR) from the reference respiratory signal of MIMIC-II. If RRs from both algorithms have diference of less than 2 breaths/min, their 'mean' will be used as the reference (or gold standard) respiratory rate. However, arspec.m was not showing a good result and most of the RR from arspec.m came out as 'NaN'. In this report, the range of autoregressive order for arspec.m has been specified correctly. Another algorithm has been included for calculating the RR, i.e. ref_cto.m (Peter Charlton), a time-domain function which search the valid breathing cycles by evaluating the respiratory signal peaks and troughs. For the RR estimation from PPG, the algorithms reported in progress report 26 are being used.

The first assignment for this week is to derive RR from reference signals of MIMIC-II, CapnoBase, Dialysis 1 and Dialysis 2. The pre-processing of raw reference respiratory signals include a -3dB cutoff of 1 Hz. For each patient's data, the recorded signals have been divided into 32-s window. In each window, both RRs (reference and estimation) are calculated. For example in MIMIC-II, which contains 8-min recording, there are 15 windows. The main objective is to get the 'mean' of the RR ref and RR estimation from those 15 windows. Windows which have 'NaN' values and have RR difference of 8 breaths/min, or both, are removed from the mean calculation. Figures 1, 2, 3 and 4 show the estimation and reference RR for MIMIC-II, CapnoBase, Dialysis 1 and Dialysis 2, respectively. Dialysis 3 has some processing errors during down sampling process as it contains negative integer data. This issue will be solved soon. The statistical data from this analysis is shown in Table I.

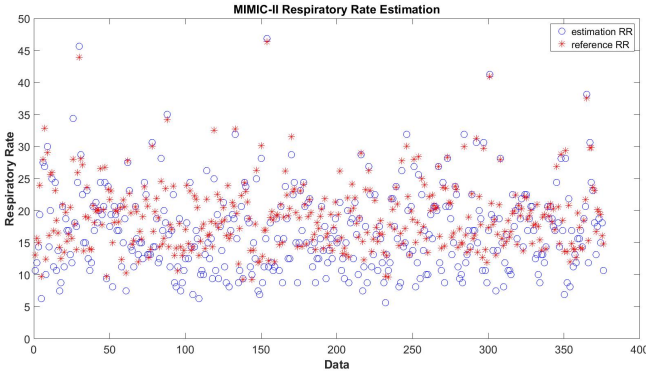

Fig. 1. MIMIC-II

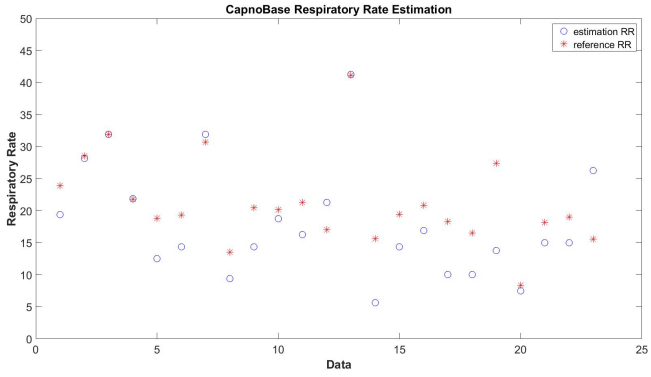

Fig. 2. CapnoBase

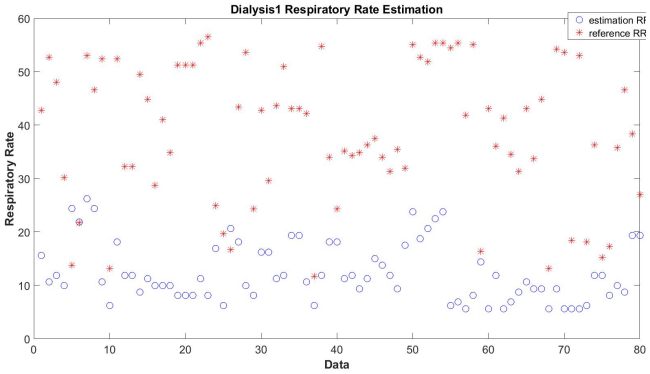

Fig. 3. Dialysis 1

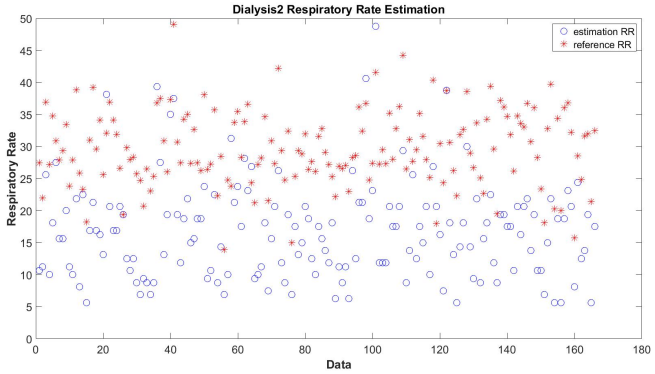

Fig. 4. Dialysis 2

TABLE I
STATISTICAL DATA

	MIMIC-11	CapnoBase	Dialysis 1	Dialysis 2
N (Data)	376	23	80	166
MAE	2.9	4.6	26.7	13.2
RSME	3.7	5.8	29.6	13.9
Mean RR (ref)	19.0	38.7	29.6	29
Variance RR (ref)	28.6	48.4	168.1	34.9
Mean RR (est)	16.7	18.1	12.4	16
Variance RR (est)	41.7	77.3	30.0	58.2

III. DISCUSSION

In this analysis, MIMIC-II and CapnoBase datasets show mean absolute error of 2.9 and 4.6, respectively. As this moment, the results for Dialysis 1 and 2 are still not that good. Further detail study on these 2 datasets and those data which shows 'NaN', which makes our sample data smaller, will be carried out.