Vortal dataset and roadmap for RR estimation paper

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I. Objective

1) To present Vortal dataset.
2) To present a publication roadmap for the respiratory rate estimation from PPG.

II. Vortal datasets and Smart Fusion

In progress report 24, algorithm validations using synthetic datasets have been done. In this report, Vortal dataset has been added and analyzed. Now, there are eight datasets available for RR estimation project. The updates for the dataset are described in Table I. There are 78 PPG data in Vortal; 39 data taken from young subjects at 'rest' and the other half are 'recovering from exercise'. All Vortal's PPG data have been evaluated for their SQI. 37/39 data at rest have median SQI of $>$0.8, while 38/39 data from the recovering group have $>$0.8 median SQI. The graphs for median SQI for both Vortal conditions are shown in Fig. 1 and Fig. 2. This report also presents the 'fusion' and 'smartfusion' functions which have been applied to the estimated RR gained from RIIV, RIAV and RIFV. The smartfusion function has been validated using synthetic (simulated) data prepared by Mr. Carlton. The results are as shown in Fig. 3. From the results, 'fusion' function has estimated 82/192 (42.7%) respiratory rate which are within 3 breath/min. In this report, 3 br/min is taken as the threshold for good and bad estimation. On the other hand, 'smart fusion' has 55/192 (28.6%) respiratory rate estimated within 3 br/min, when comparing to the reference respiratory rate. Afterthat, fusion and smartfusion are applied to Vortal datasets too. For the dataset at rest (refer Fig. 4), 'fusion' estimated 19/39 (48.7%) and 'smartfusion' gives 15/39 (38.4%) of respiratory rate that are within 3 br/min. For dataset of recovering from exercise (refer Fig. 5), 'fusion' provides 13/39 (33.3%) and 'smartfusion' extracted 12/39 (30.8%) respiratory within 3 br/min. It is understood that from the algorithm, if the standard deviation of the RIIV, RIAV and RIFV is $>$4, 'smartfusion' will be taken as NA. Further work on this will be using a few statistical tools.

TABLE I
Dataset information for RR estimation

	MIMIC-II	CapnoBase	Dialysis1	Dialysis2	Dialysis3	Calms-2	Picram	Vortal
PPG Data Available	✓	✓	✓	✓	✓	✓	✓	✓
⇑bspprojects9\OURR	✓	✓	✓	✓	✓	✓	O[a] : ✓ R[b]:✓	✓
PPG Records	954	42	96	574	374	336	O:199, R:68	78 (Re[c]:39, E[d]:39)
Reference Resp	950	42	96	574	374	(getting info)	O: 0, R: 0	78
Recording time	8 min	8 min	4.9∼5.2 h	2.3∼4.4 h	0.8∼6.0 h	0.2 h∼30.9 d	O: max 75.2 d	9∼11.7 min
Sampling Freq (Hz)	125	300	75	75	256	75	75	500
Med PPG SQI$>$ 0.8	839(88%)	42(100%)	93(97%)	525(92%)	300(80%)	327(97%)	O:103(52%),R:30(44%)	Re:37(95%),E:38(96%)
Resp. Sig Extraction	✓	✓	✓	✓	✓	✓	✓	✓

[a]Oxford
[b]Reading
[c]Rest condition
[d]Recovering from exercise

III. Roadmap for RR estimation paper

Until now, there are eight datasets which contain PPG signals as shown in Table I, stored in our bspprojects9 OURR. Only six datasets have reference respiratory signals. We also have SQI results for all the datasets. Respiratory signal estimation algorithms have also been applied to those datasets and the latest results show that it worked fine with all the datasets. The RR estimation algorithms have been validated using synthetic datasets and the results shows 80% are correct. Finally this week, 'fusion' and 'smartfusion' algorithms have been used to synthetic and Vortal datasets.

Further experimentations that need to be done are (i) applying the 'fusion' algorithms to the other seven datasets and (ii) to reduce the RR estimation error, (this probably will take a some time on the algorithms) and (iii) to run a few statistical tools to evaluate the results, compare to the reference respiratory rate.

IV. Conclusion

Fusion has been applied to the synthetic and Vortal datasets. For Vortal datasets, 'fusion' shows ∼40% and 'smartfusion' shows ∼34% estimation within 3 br/min error. A statistical tool wiill be used when applying the fusion to other datasets.

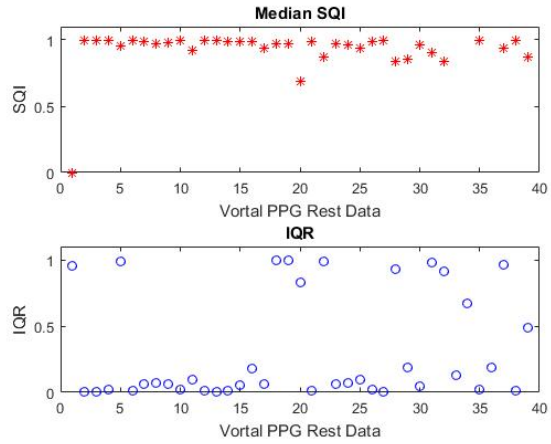

Fig. 1. Med SQI and IQR for Vortal at rest

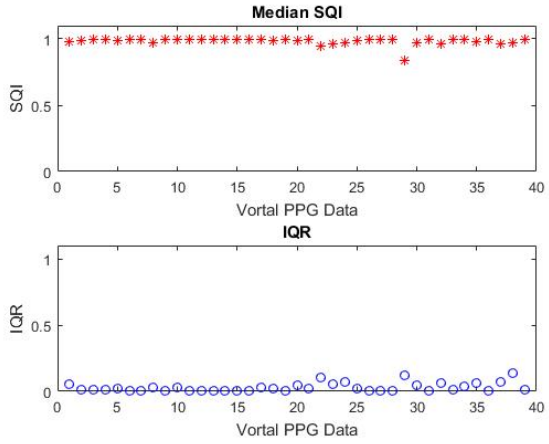

Fig. 2. Med SQI and IQR for 'recovering from exercise' Vortal data

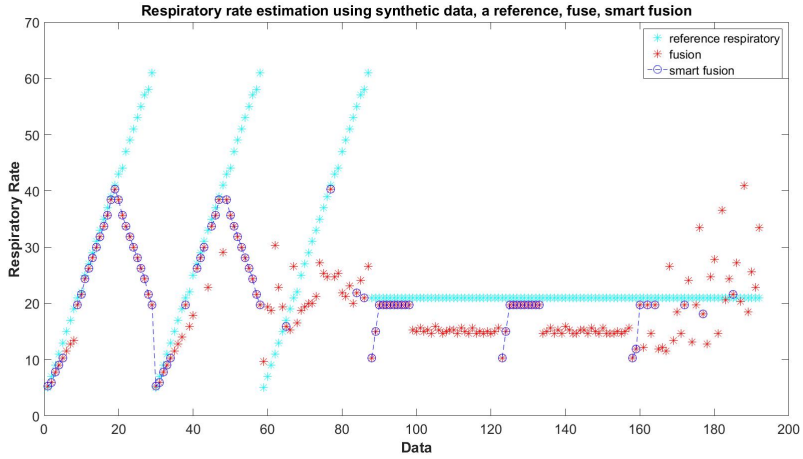

Fig. 3. Using the synthetic data, RIIV, RIAV and RIFV have been calculated. Fusion and Smartfusion function have been applied and the reference respiratory has also been plotted in this graph

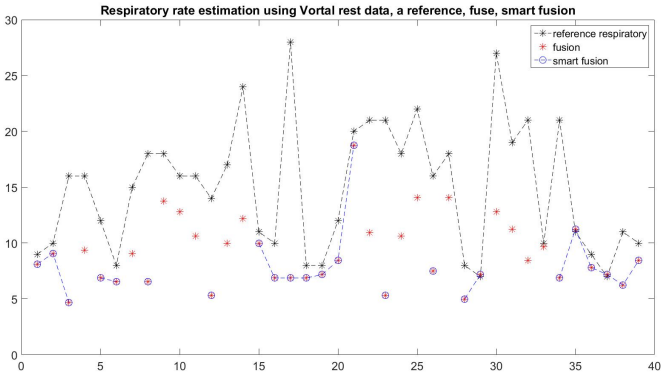

Fig. 4. Vortal at rest

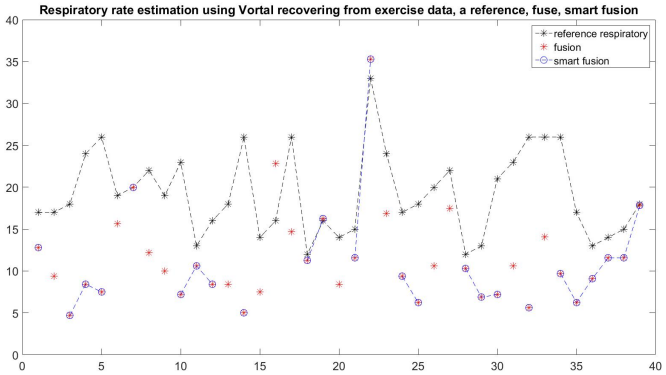

Fig. 5. Vortal for the 'recovering from exercise' datasets