The effect of measurement trends in belt breathing sensors

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Background

Continuous monitoring of physiological signals is frequently used by healthcare professionals.

When measuring physiological signals through wearable devices for a relatively prolonged time, signals show some trend, which is a systematic increase or decrease on the obtained signal due movements of the system or subject.

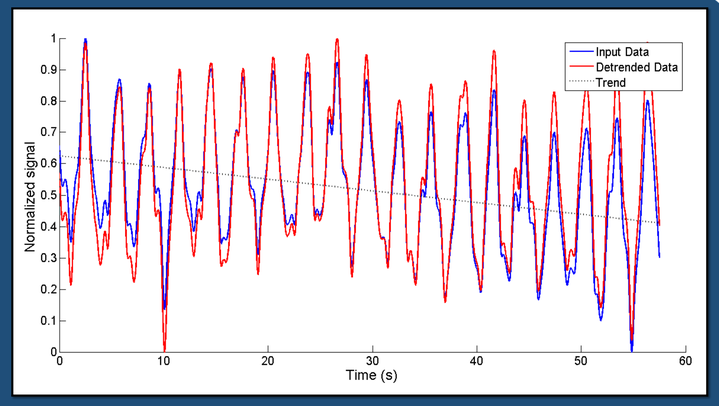
Linear fit can be applied offline to the obtained respiration signal to mitigate this effect, as these trends may hinder the data analysis

Research objectives

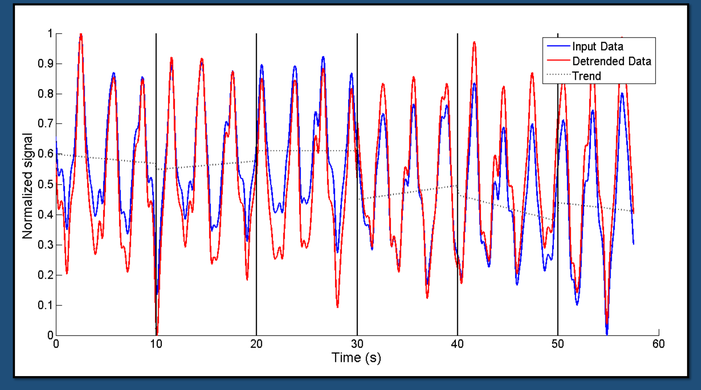
Compare two different methods to remove trends from respiration signals and compare the predicted respiration rate obtained from two different algorithms

Methods

Respiration signals were obtained from 21 volunteers, whom for five different activities followed six different respiration rates set by a metronome. Two different detrending methods are used on respiration signals.



Detrending method 1
Detrends the whole original signal before applying the algorithms



Detrending method 2
Detrends the original signal by segments while applying the algorithms on each segment

Results

When applying detrending method 1, algorithm 1 decreases relative error from predictions of respiration rate by 1.08% in average; with a segmentation window of 11 seconds relative error decreases up to 2.52%. Algorithm 2 decreases relative error by 0.48% in average; with a segmentation window of 30 seconds, relative error decreases up to 1.78%.

On the other hand, with detrending method 2, algorithm 1 decreases relative error by 1.54% in average, and up to 3.19% for a segmentation window of 11 seconds. With algorithm 2 relative error decreases by 1.28% in averages, and up to 2.88% with a segmentation window of 30 seconds.

	Algorithm 1		Algorithm 2	
	AI[1]	MI[2]	AI[1]	MI[2]
Method 1	1.08%	2.52%	0.48%	1.78%
Method 2	1.54%	3.17%	1.28%	2.88%

[1]Average improvement
[2]Maximum improvement

Conclusions

Even though both detrending methods show an improvement when calculating respiration rate when compared with the original signal, for this specific application detrending method 2 shows a better performance.