ANALYSIS OF METHANE IN EXHALED BREATH USING PLASMA OPTICAL EMISSION SPECTROSCOPY & PLS-DA ALGORITHM

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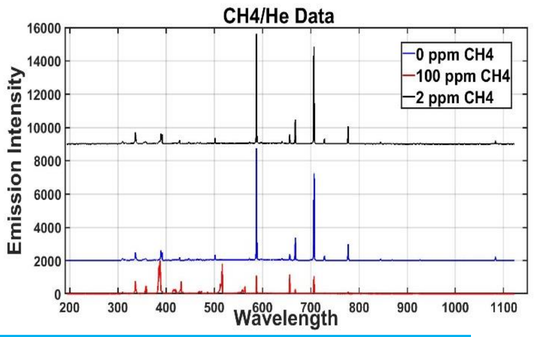
Introduction

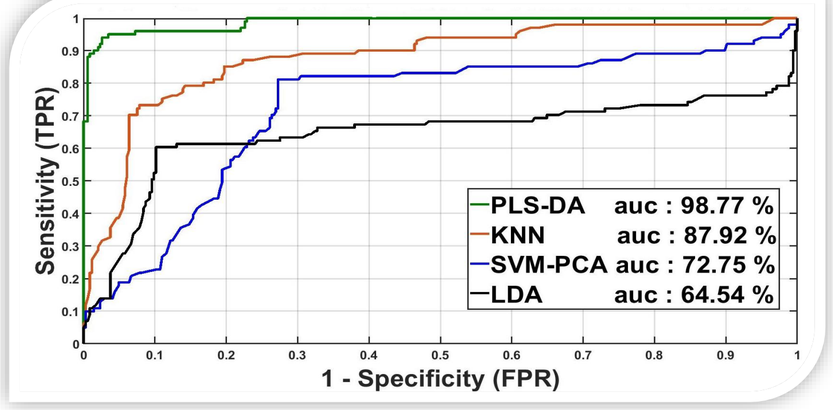
Methane (CH4) is a gas commonly found in the gastrointestinal tract of mammals. It can move from there to the systemic circulation and then is excreted by the lungs. High levels of methane in breath are potentially linked to conditions such as irritable bowel syndrome, large bowel cancer and constipation, though there is much work still to be done in determining methane's exact effect on the body and its link to disease.

CH4>1 ppm



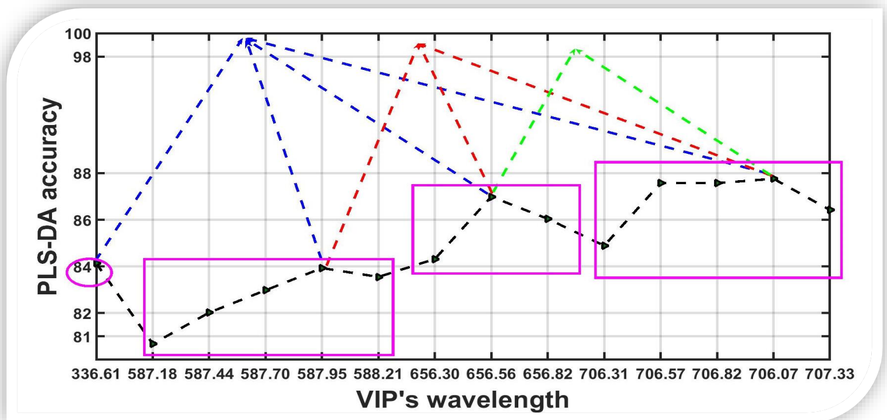
Algorithm Selection

Machine learning can play a key role in how this breath data is analysed. To distinguish methane's breath from other available factors, PLS-DA classifier is selected.



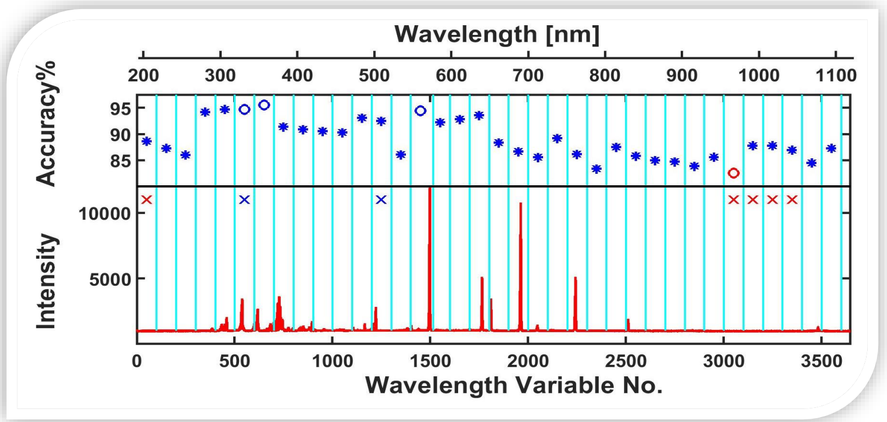
Feature Extraction

A VIP (Variable Importance in Projection) filter technique can be applied to improve the model's interpretation and identify important scores introduced with PLS-DA.



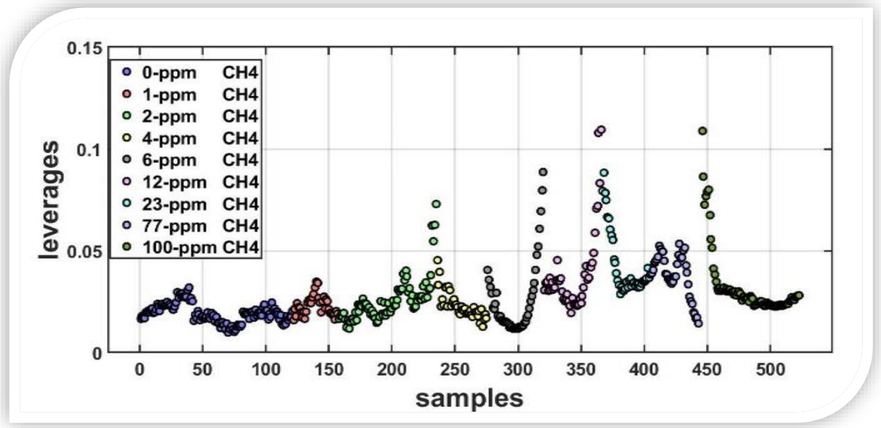
Data Segmentation

Initially the samples were partitioned into 36 subsets each containing ~100 variables where the dotted line indicates the boundary of each subset. The individual model accuracy for each subset is shown in the 'Accuracy' section.



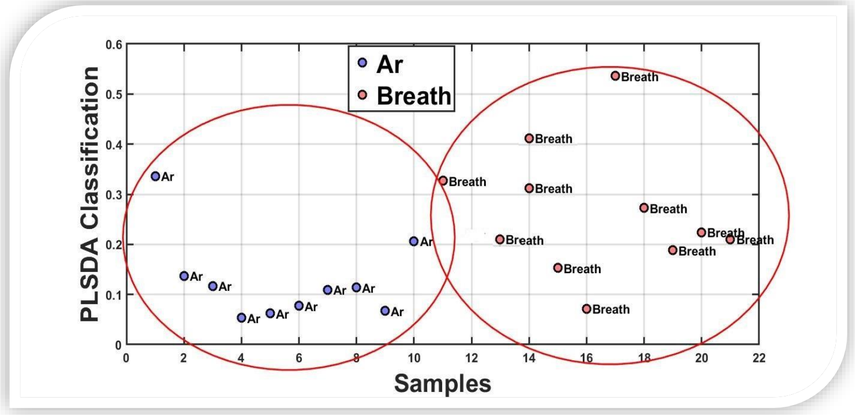
PLS-DA Classification

Classification of nine CH4 concentrations via PLSDA after feature extraction, wavelength merging and VIP extraction.



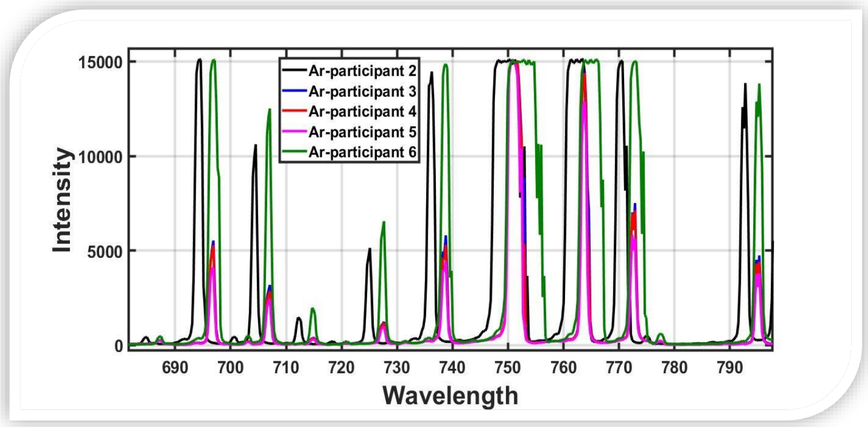
Breath - Argon

In another experiment, data from five participants is measured via NIBEC custom plasma system in a wavelength spectrum 194.43 - 1122.6 nm when argon is applied for sustain plasma.



Outcome

Argon classified from participants 3, 4 and 5 shows approximately the same trend, intensity and peak shape in wavelength interval ~700-800. In contrast, participant 2 and 6 show higher intensity, and different peak location(wavelength movement).



As further work, the intention would be to apply these algorithmic techniques to an active portable gas sensor that could quickly observe changes in a patient's breath profile, or within a given environment, to aid in the detection of harmful airborne substances carried by human breath.

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