Biodiesel exhaust gases - what impact on our cardiovascular system ?

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Diesel exhaust emission is considered a main source of air pollution, highly contributing to global warming. Added to the predicted shortage of fossil fuel, we are desperately in need of a more eco-friendly alternative. Renewable and more carbon-neutral, biodiesel is a suitable candidate to replace petrodiesel derivatives. But what about its actual effects on our cardiovascular system ?

Diesel fuel is one of the most prevalent petroleum derivatives used of our time. However, it is considered a major source of urban air pollution, and has the great disadvantage of being non renewable, which will make it irrelevant in the near future. Researches on surrogates to fossil fuels resulted in an alternative. Renewable and expected to release marginal levels of pollutants into the air, biodiesel is a potentially attractive replacement candidate. But one major point remains questionable: in many ways, diesel and biodiesel exhaust gases have similar chemical composition. Since diesel exhaust emissions have been proven to alter the pulmonary and cardiovascular systems, would it mean that biodiesel exhaust affects our body in the same manner ?

To investigate the potential relationship between biodiesel exhaust and human health, a research team developed a project at the Division of Ergonomics and Aerosol Technology of Lund University. Its general purpose is to characterize emissions from vehicles powered by renewable fuels and to determine how humans are affected by being exposed to the exhaust gases. Within the project, study participants were exposed to various gases, including biodiesel exhaust. Two types of signals were recorded during chamber studies: electrocardiograms (ECG) and photoplethysmograms (PPG) data from the participants. On this basis, how to assess the effects of gas inhalation on our organism ? For this purpose, I implemented two signal processing algorithms. Based on ECG, I computed statistical indicators related to the variations of the heart rate and looked for changes over time. Then (and that's the most important part) I implemented an algorithm which decomposes PPG pulses into Gaussian-shaped waves and checks for changes in their morphology. Since PPG pulses have been extensively studied, it is now possible to connect changes in PPG pulses with mechanical properties of the blood vessels.

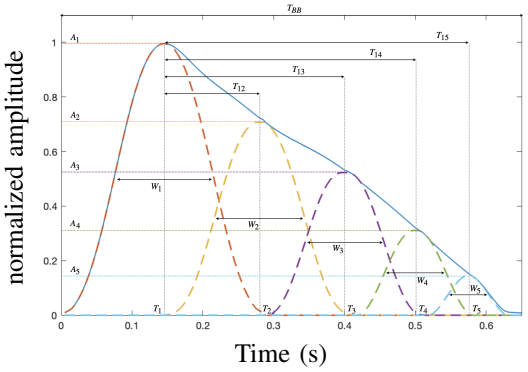

Fig. 1. Example of PPG Pulse decomposition.

We pointed out that being exposed to such emissions doesn't affect the heart rate or its variability. In contrast, the pulse decomposition analysis indicated that it could induce an increase in arterial stiffness after three hours into exposure. These effects are similar to those observed in persons exposed to diesel exhaust gases. In addition, we noticed that the range of responses of the participants to the pulse morphology analysis, as well as to the study of heart rate, was very large. It is of course partly related to the quality of ECG and PPG recordings. But it gives also rise to questions regarding the natural high variability of the results. Could it have overwhelmed some other minor changes linked to biodiesel exposure ? On the other hand, it questions the statistical relevance of a study based on only two dozen people.

Concluding, this study is one of the first to investigate the acute effects of exposure to biodiesel exhaust on cardiovascular system in human. It is of major interest to pursue studies on this subject, especially if this alternative fuel is increasingly used in the near future. In addition, PPG is a simple, low cost and non-invasive method. Along with the implemented pulse decomposition algorithm, it could prove very useful for assessing changes in vascular compliance properties in various future applications.