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I, Gerard P. Grenier, am over twenty-one (21) years of age. I have never been convicted of a felony, and I am fully competent to make this declaration. I declare the following to be true to the best of my knowledge, information and belief:

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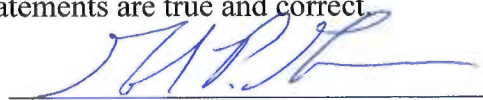
A.	G. Comtois, et al. “A Comparative Evaluation of Adaptive Noise Cancellation Algorithms for Minimizing Motion Artifacts in a Forehead-Mounted Wearable Pulse Oximeter” 28 <sup>th</sup> Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2007, August 22-26, 2007.
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11. G. Comtois, et al. "A Comparative Evaluation of Adaptive Noise Cancellation Algorithms for Minimizing Motion Artifacts in a Forehead-Mounted Wearable Pulse Oximeter" was published in the 28<sup>th</sup> Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2007. The 28<sup>th</sup> Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2007 was held from August 22-26, 2007. Attendees of the conference were provided copies of the publication no later than the last day of the conference. The article is currently available for public download from the IEEE digital library, IEEE Xplore.
  
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# A Comparative Evaluation of Adaptive Noise Cancellation Algorithms for Minimizing Motion Artifacts in a Forehead-Mounted Wearable Pulse Oximeter

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### Abstract:

Wearable physiological monitoring using a pulse oximeter would enable field medics to monitor multiple injuries simultaneously, thereby prioritizing medical intervention when resources are limited. However, a primary factor limiting the accuracy of pulse oximetry is poor signal-to-noise ratio since photoplethysmographic (PPG) signals, from which arterial oxygen saturation (SpO<sub>2</sub>) and heart rate (HR) measurements are derived, are compromised by movement artifacts. This study was undertaken to quantify SpO<sub>2</sub> and HR errors induced by certain motion artifacts utilizing accelerometry-based adaptive noise cancellation (ANC). Since the fingers are generally more vulnerable to motion artifacts, measurements were performed using a custom forehead-mounted wearable pulse oximeter developed for real-time remote physiological monitoring and triage applications. This study revealed that processing motion-corrupted PPG signals by least mean squares (LMS) and recursive least squares (RLS) algorithms can be effective to reduce SpO<sub>2</sub> and HR errors during jogging, but the degree of improvement depends on filter order. Although both algorithms produced similar improvements, implementing the adaptive LMS algorithm is advantageous since it requires significantly less operations.

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### I. Introduction

The implementation of wearable diagnostic devices would enable real-time remote physiological assessment and triage of military combatants, firefighters, miners, mountaineers, and other individuals operating in dangerous and high-risk environments. This, in turn, would allow first responders and front-line medics working under stressful conditions to better prioritize medical intervention when resources are limited, thereby extending more effective care to casualties with the most urgent needs.

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plethysmography, accelerometers, blood vessels, cardiology, least mean squares methods, oximetry, oxygen, patient diagnosis

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recursive least square algorithm, adaptive noise cancellation algorithms, motion artifacts, wearable pulse oximeter, photoplethysmographic signals, arterial oxygen saturation, heart rate, least mean squares algorithm

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