



### DECLARATION OF GERARD P. GRENIER

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:

1. I am Senior Director of Publishing Technologies of the Institute of Electrical and Electronics Engineers, Inc. ("IEEE").
2. IEEE is a neutral third party in this dispute.
3. Neither I nor IEEE itself is being compensated for this declaration.
4. Among my responsibilities as Senior Director of Publishing Technologies, I act as a custodian of certain records for IEEE.
5. I make this declaration based on my personal knowledge and information contained in the business records of IEEE.
6. As part of its ordinary course of business IEEE publishes and makes available technical articles and standards. These publications are made available for public download through the IEEE digital library, IEEE Xplore.
7. It is the regular practice of IEEE to publish articles and other writings including article abstracts and make them available to the public through IEEE Xplore. IEEE maintains copies of publications in the ordinary course of its regularly conducted activities.
8. The article below has been attached as Exhibit A to this declaration:

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.
----	---

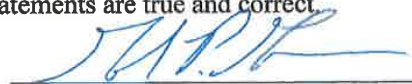
9. I obtained a copy of Exhibit A through IEEE Xplore, where it is maintained in the ordinary course of IEEE's business. Exhibit A is a true and correct copy of the Exhibit as it existed on or about October 25, 2016.
10. The article abstracts from IEEE Xplore shows the date of publication. IEEE Xplore populates this information using the metadata associated with the publication

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.

12. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

I declare under penalty of perjury that the foregoing statements are true and correct.

Executed on: 25 Oct. 2016

A handwritten signature in blue ink, appearing to be "J. P. R.", written over a horizontal line.

# EXHIBIT A

0003

**Institutional Sign In**

[BROWSE](#)

[MY SETTINGS](#)

[GET HELP](#)

[WHAT CAN I ACCESS?](#)

[SUBSCRIBE](#)

Browse Conferences > Engineering in Medicine and B...

[Back to Results](#)

## A Comparative Evaluation of Adaptive Noise Cancellation Algorithms for Minimizing Motion Artifacts in a Forehead-Mounted Wearable Pulse Oximeter

### Related Articles

Real-Time Recognition of Physical Activities and ...

A Wearable Reflectance Pulse Oximeter for Remote ...

Active noise cancellation using MEMS acceleromete...

**Purchase or Sign In**  
to View Full Text

**9**  
Paper Citations

**2**  
Patent Citations

**609**  
Full Text Views

**3**

Author(s)

Gary Comtois ; Yitzhak Mendelson ; Piyush Ramuka

[View All Authors](#)

**Abstract**

[Authors](#)

[Figures](#)

[References](#)

[Citations](#)

[Keywords](#)

[Metrics](#)

[Media](#)

### 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.

**Published In:** Engineering in Medicine and Biology Society, 2007. EMBS 2007. 29th Annual International Conference of the IEEE

**Date of Conference:** 22-26 Aug. 2007

**INSPEC Accession Number:** 9910101

**Date Added to IEEE Xplore:** 22 October 2007

**DOI:** 10.1109/EMBS.2007.4352592

**ISBN Information:**

**Publisher:** IEEE

**ISSN Information:**

**PubMed ID:** 18002258

### ☰ Contents

[Download PDF](#)

#### 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.

[Download Citations](#)

[Full Text](#)

[View References](#)

[Abstract](#)

[Email](#)

[Read document](#)

[Authors](#)

[Print](#)

**Keywords**

[Figures](#)

<http://ieeexplore.ieee.org/document/4352592/>

0004

1/3

- Request Permissions
- Export
- Share
- Alerts

**Related Articles**

- » Real-Time Recognition of Physical Activities and ...  
Emmanuel Munguia Tapia; S...
- » A Wearable Reflectance Pulse Oximeter for Remote ...  
Y. Mendelson; R. J. Duckw...
- » Active noise cancellation using MEMS acceleromete...  
H.H. Asada; Hong-Hui Jia...
- » Unobstrusive heart rate and respiratory rate moni...  
Octavian Postolache; Pedr...
- » Reducing motion artifact in wearable bio-sensors ...  
P. Gibbs; H.H. Asada
- » Estimation of respiratory waveform using an accel...  
P.D. Hung; S. Bonnet; R. ...
- » Pulse arrival time and ballistocardiogram applica...  
Eduardo Pinheiro; Octavia...
- » Development of real-time motion artifact reductio...  
Hyonyoung Han; Min-Joon K...
- » Survey and evaluation of real-time fall detection...  
James T. Perry; Scott Kel...

**IEEE Keywords**

Noise cancellation, Biomedical monitoring, Pulse measurements, Heart rate, Least squares approximation, Injuries, Limiting, Signal to noise ratio, Fingers, Motion measurement

**INSPEC: Controlled Indexing**

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

**INSPEC: Non-Controlled Indexing**

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

Algorithms, Artifacts, Clothing, Diagnosis, Computer-Assisted, Forehead, Humans, Monitoring, Ambulatory, Movement, Reproducibility of Results, Sensitivity and Specificity

**Authors**

**Gary Comtois**  
Member IEEE, Graduate Student, Department of Biomedical Engineering, Worcester Polytechnic Institute, Worcester, MA 01609 USA.  
comtoisg@wpi.edu

**Yitzhak Mendelson**  
Member IEEE, Professor, Department of Biomedical Engineering, Worcester Polytechnic Institute, Worcester, MA 01609 USA. phone: 508-831-5103; fax: 508-831-5541; email: ym@wpi.edu

**Piyush Ramuka**  
Graduate Student, Department of Biomedical Engineering, Worcester Polytechnic Institute, Worcester, MA 01609 USA. pramuka@wpi.edu

References

Citations

Keywords

Back to Top

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.